Exhibit A

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF VIRGINIA
(RICHMOND DIVISION)

GOLDEN BETHUNE-HILL, *et al.*, Plaintiffs, v. VIRGINIA STATE BOARD OF ELECTIONS, *et al.*, Defendants.	Civil Action No. 3:14-cv-00852-REP-AWA-BMK

FIRST SUPPLEMENTAL DECLARATION OF THOMAS BROOKS HOFELLER, Ph.D.

OBJECTIVES OF DECLARATION

1. I have been asked to examine the Report of Jonathan Rodden and to evaluate its relevance to the second hearing in this case due to a remand from the United States Supreme Court, I read this report and found it so incomplete as to be of little value to the facts of this case. There is simply insufficient data for a thorough examination of the views expressed by Dr. Rodden.

QUALIFICATIONS

2. My qualifications have already been provided in my first expert report for this case submitted to the court on April 10, 2015. My updated resume is contained in my report in *Vesilind v. Virginia State Board of Elections* presented to the Circuit Court for the City of Richmond, Virginia on January 18, 2017. This report is attached as an

appendix to this current report. I reconfirm the data and conclusions contained in my first report in the *Bethune-Hill* case.

COMMENTS ON THE RODDEN REPORT

3. Along with his narrative, Dr. Rodden provided a series of dot density maps to demonstrate "the spatial arrangement" of the voting age African-American and white population. While I personally find these maps interesting, they are difficult to read and would be enhanced by the addition of more color.

4. While, during my 50 years of experience of actual redistricting plan drafting, I have experimented with such maps, I long ago rejected this form of thematic display because of two reasons. First, the maps are difficult for many line-drafters to understand and to grasp the information required for actual line drawing. Second, redistricting is done using discrete geographic areas such as counties, voting districts (called VTDs by the United States Census Bureau), and census blocks. It is much more useful to display one or more values for each geographic area using actual numbers and thematic coloring. Simply put, one does not select "dots" representing the actual demographics of individuals within the unit of geography for which the dots are being generated. All of the individuals in the selected area of geography must be included in the district, regardless of each person's individual demographic characteristics. The dot patterns also obscure clear display of other information which is useful for actual districting.

5. Dr. Rodden is critical of the way in which 11 of Virginia's 12 majority African-American districts were constructed in HB-5005. His objection to the House of Delegates' use of split VTDs is clear, but this issue was previously covered by another expert who testified in the first hearing on this case. The demographic characteristics of

either side of these splits were also covered. There is no new information here except for the fairly complex, yet obscuring mapping techniques. Dr. Rodden also asserts that the choices of which geographic units, or portions of these units, to include in each of the 11 African-American districts was primarily determined by a desire to create districts with an adult population of 55% or more.

6. In my 2015 report, I outlined that corrected population deficiencies in both the African-American districts and the *other 2010 baseline districts surrounding them* was a significant factor in the placement of the 2011 districts. I also discussed the fact that use of geographic regions also guided the map drafting of the 2011 map.

7. The drafters of HB-5005 were faced with many difficult decisions in addition to the challenge of dealing with the existing 12 African-American contained in the 2010 base map. Virginia had experienced significant population growth over the previous decade which caused significant overpopulation of individual districts in Northern Virginia and underpopulation on the southeastern portion of the state including the Richmond and Tidewater areas. The 12 existing African-American districts were severely underpopulated as were many of the surrounding non-minority districts. It would have been far simpler to collapse one of these minority districts and to resurrect it as a non-minority district in the high-growth population areas of the state.

8. The problem with this strategy was that it would have been a retrogression of the minority representation of the state and, as such, would have almost certainly drawn an objection from the Justice Department under the provisions of Section 5 of the Voting Rights Act. Virginia's extremely tight redistricting timeframe did not allow any

redistricting strategy which would have allowed time for redrafting of HB-5005 and taking it though another Section 5 approval process.

9. Adding to this was that the districts created were clearly requested by the African-American delegates, who supported HB-5005. All but one African-American delegate voted for the plan, with the exception being a delegate who did not believe that her district had a high enough African-American percentage. African-American views of the plan would have been a significant factor in the Justice Department's approval of HB-5005.

10. In addition, African-American, as well as non-minority delegates, were also concerned about core retention in their districts. The situation was fully discussed at the previous hearing and my report for the first phase of this case. The high level of retention of the cores of the 2010 districts in the 2011 maps required more awkward construction of the new districts.

11. Dr' Rodden also suggest that the plan drafters should have considered other geographic boundaries such as school attendance boundaries and types of housing information. The problem with this viewpoint is that such boundaries were not contained in the statewide databases which were available at the time of the time period in which the plan had to be drafted. Since the geography used was the Census Bureau's TIGER file, it did not contain much of this local geography and what was there would have been, for the most part, outdated. Also, school attendance boundaries are in constant flux and would be virtually impossible to collect on a statewide basis. This problem is demonstrated by articles found in Richmond media included in the Appendix which indicates how the attendance boundaries have been

recently changed in Richmond. These articles may be found by opening the following links on the internet: http://wtvr.com/2012/05/21/richmond-schools-slated-for-closure-following-rezoning/, https://rvanews.com/news/schools/93866, http://wric.com/2017/03/07/richmond-school-board-may-consider-rezoning-to-remedy-ongoing-issues/, http://www.richmond.com/news/local/education/city-of-richmond/richmond-school-board-signals-action-on-redistricting-and-rezoning-possibly/article_4ad863bf-2acf-5668-a9c7-a1294118b2c7.html, http://www.richmond.com/news/local/city-of-richmond/i-ll-help-carry-boxes-richmond-school-board-members-debate/article_d6d28a19-0d7f-5116-af95-c9ad099a6aa8.html.

12. The Census Bureau has enough trouble keeping up with the corporate limits of cities, town and villages as well as the other minor civil divisions it tracks. As the former staff director of the U. S. House Subcommittee on the Census, I am well aware that the boundary and annexation survey process for these units of geography is the bane of the Geography Division of the Census Bureau.

13. The drafters of HB-5005 would have had enough difficulty dealing with the available census geography and the conflicted policy decisions involved in the redistricting process in the legislative process. All this information is fine for academic study of what was done by the General Assembly after the fact, but it is simply naïve to propose the information overload Dr. Rodden proposes would be reasonable to include in the drafting of a real-time legislative enacted plan.

14. The problem with Dr. Rodden's report is that, even to an experienced line-drafter, it is impossible to exactly determine the boundaries of his proposed alternative

districts. Because of this, it is also impossible to determine just how his proposed alternative districts would fit into a complete House of Delegates map for the entire state.

15. Dr. Rodden also suggests that his proposed method of line-drafting would improve compactness by lowering the overall African-American voting age percentages by a few percentage points. Notwithstanding, whether or not this makes any legal difference, I was unable, from the information contained in his report, to determine what his overall racial characteristics would have been, let alone the actual boundaries of his districts.

16. Dr. Rodden further asserts that his proposed districts are more compact. But without the proposed boundaries it is impossible to run meaningful compactness tests to determine the relative compactness of his districts with those contained in HB-5005. Dr. Rodden presents no quantitative numbers or sufficiently detailed maps to allow a complete evaluation of his compactness claims.

17. A reading of Rodden's report indicates changes he suggested could be made in modifying the 2010 Baseline Delegate Districts to bring them into conformity with what Dr. Rodden suggest are the standards and policy choices which the General Assembly should have made. These modified districts may be inserted into the map of HB-5005 and new population and deviation statistics can be produced for a modified HB-5005. My reading of Dr. Rodden's report leads me to a conclusion that Dr. Rodden did not intend to actually develop an alternative to HB-5005. If he did, he certainly did not document it for the court. If he did not then his report does not add significantly to the debate on the merits of the challenged districts in HB-5005.

18. However, given that the deviations in the challenged districts, as a well as other districts, would have to be resolved, while maintaining district cores and avoiding pairing of incumbents, as well as other conflicting criteria, it is dubious that Rodden's suggested changes would increase the overall compactness of HB-5005. This illustrates the basic problem of attempting to examine any individual district in a map without considering the changes required in the entire plan. Suggested changes must be presented in the form of a completely revised statewide plan.

19. It has also been determined, as a result of the decision in the *Vesilind* case, that HB-5005's districts are sufficiently compact to meet the Virginia Constitution's compactness requirement for legislative redistricting. This subject was fully discussed in the *Vesilind* case and also in the resulting decision by the court.

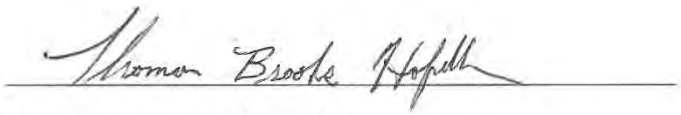
CONCLUSIONS

20. For all the reasons cited above, it is clear that this report, while of academic interest in studying the differences between the House of Delegates' 2001 and 2011 maps and presenting some interesting new types of maps, adds little to the discussion of the issues involved in this case which were presented in the original hearing.

21. Drawing conclusions regarding HB-5005 without the production of an accompanying completely new statewide sample plan, accompanied by a block assignment file, does not allow added substantial value to a discussion of the issues involved in this case. Simply stated, Dr. Rodden's report does not document how his objections would change the configuration of HB-5005. Because of this, the report can not substantiate the conclusions Dr Rodden reached

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 15th day of August, 2017



Thomas Brooks Hofeller, Ph.D.

Appendix

STATE OF V I R G I N I A

IN THE CIRCUIT COURT FOR THE CITY OF RICHMOND

RIMA FORD VESILIND; ARELIA LANGHORNE; SHARON SIMKIN; SANDRA D. BOWEN; ROBERT S. UKROP; VIVIAN DALE SWANSON; H.D. FIEDLER; JESSICA BENNETT; ERIC E. AMATEIS; GREGORY HARRISON; MICHAEL ZANER; LINDA CUSHING; SEAN SULLIVAN KUMAR; and DIANNE BLAIS, Plaintiffs,	)	
v.	)	**Case No. 15003886-0**
VIRGINIA STATE BOARD OF ELECTIONS; JAMES B. ALCORN, IN HIS CAPACITY AS CHAIRMAN OF THE VIRGINIA STATE BOARD OF ELECTIONS; CLARA BELLE WHEELER, IN HER CAPACITY AS VICE-CHAIR OF THE VIRGINIA STATE BOARD OF ELECTIONS; SINGLETON B. MCALLISTER, IN HER CAPACITY AS SECRETARY OF THE VIRGINIA TATE BOARD OF ELECTIONS; THE STATE DEPARTMENT OF ELECTIONS; AND EDGARDO CORTÉS, IN HIS CAPACITY AS COMMISSIONER OF THE STATE DEPARTMENT OF ELECTIONS, Defendants.	)	

EXPERT REPORT OF THOMAS BROOKS HOFELLER, Ph.D.

1. I am a recognized expert in the fields of districting and reapportionment in the United States. I have been retained, as an independent consultant, through counsel by Intervenor-Defendants House Speaker William Howell and the Virginia House of Delegates to provide expert testimony in this case. My hourly rate is $300 per hour.

OBJECTIVES OF DECLARATION

2. I have been asked to determine whether H.B. 5005, the legislation redistricting plan enacted in 2011 by the Virginia General Assembly to redistrict Virginia's House of Delegates following the 2010 U.S. Census, is compact and contiguous.

3. Based on my review of the maps and data reflecting H.B. 5005, as well as data and maps from other states, and my experience in drafting and evaluating districting plans for compactness all across the nation for five decennial redistricting cycles, it is my opinion that the 2011 Virginia House of Delegates Plan, H.B.-5005, is compact and compares favorably in terms its level of compactness to other Virginia legislative plans and plans from other states.

4. Based on my review of the geography of HB 5005, I have also determined that there are no contiguity issues with regard to the 2011 House of Delegates Plan.

QUALIFICATIONS

5. I set forth here a summary of my experience that is most relevant to this testimony. The full range of my professional qualifications and experience is included in my resume, which is attached as Appendix 1.

6. I am a Partner in Geographic Strategies, LLC, located in Columbia, South Carolina. Geographic Strategies provides redistricting services including database construction, strategic political and legal planning in preparation for actual line drawing, support services and training on the use of geographic information systems (GIS) used in redistricting, analysis of plan drafts, and actual line-drawing when requested. The corporation and its principals also provide litigation support.

7. I hold a Ph.D. from Claremont Graduate University, where my major fields of study were American political philosophy, urban studies and American politics. I hold a B.A. from Claremont McKenna College with a major in political science.

8. I have been involved in the redistricting process for over 50 years, and have played a major role in the development of computerized redistricting systems, having first supervised the construction of such a system for the California State Assembly in 1970-71, as well as playing an important role in the development of redistricting mapping systems as a recognized nationwide expert in this area.

9. I have been active in the redistricting process leading up to and following each decennial census since 1970. I have been intimately involved with the construction of databases combining demographic data received from the United States Census Bureau with election information which is used to determine the probable success of parties and minorities in proposed and newly enacted districts. Most of my experience has been related to congressional and legislative districts, but I have also had the opportunity to analyze municipal and county-level districts. In the *Bethune* case[1]. I submitted an expert report and gave trial testimony regarding the compactness and contiguity of HB 5005, which is the same redistricting plan at issue in this case.

10. I served for a year and one half as Staff Director for the U. S. House Subcommittee on the Census in 1998-99. Because of my service in this position, as well as my experience in the detailed use of both census data and census geography, I am particularly qualified to offer testimony on the application of census geography to the measurement of district compactness.

[1] Golden Bethune-Hill v. Virginia State Board of Elections, Civil Action No. 3:14-cv-00852 (United States Court for the Eastern District of Virginia – Richmond Division 2015)

11. I have drafted and analyzed plans in most states including, but not limited to, California, Nevada, Arizona, New Mexico, Colorado, Texas, Oklahoma, Kansas, Missouri, Minnesota, Wisconsin, Illinois, Indiana, Ohio, Arkansas, Mississippi, Louisiana, Alabama, Georgia, Florida, South Carolina, North Carolina, Virginia, New York, New Jersey and Massachusetts. In this decennial round of redistricting, I have been intensely involved in Texas, Missouri, Alabama, North Carolina, Virginia and Massachusetts.

12. I have given testimony as an expert witness in a number of important redistricting cases including, but not limited to, Gingles v. Edmisten, 590 F. Supp. 345 (N.D.N.C. 1984), *aff'd in part and rev'd in part* Thornburg v. Gingles 478 U.S. 30 (1986); State of Mississippi v. United States, 490 F. Supp. 569 (D.C.D.C. 1979); Shaw v. Hunt, 92-202-CIV-5-BR, U.S. District Court for the Eastern District of North Carolina, Raleigh Division (1993-4); Ketchum v. Byrne, 740 F,2d 1398, *cert. denied* City Council of Chicago v. Ketchum, 471 U.S. 1135 (1985), *on remand*, Ketchum v. City of Chicago 630 F. Supp. 551 (N.D. Ill. 1985); and Arizonans for Fair Representation v. Symington, CIV 92-0256, U.S. District Court Arizona (1992), *aff'd mem. sub nom*. Arizona Community Forum v. Symington, 506 U.S. 969 (1992), David Harris v. Patrick McCrory, Civil Action No. 1:13 CV-00949 (United States District Court, Middle District of North Carolina Durham Division 2013) and North Carolina State Conference of the NAACP v. Patrick Lloyd McCrory, 1:13 CV-658 (United States District Court, Middle District of North Carolina 2013).

13. I have done considerable work regarding compactness as a criterion in redistricting maps, including but not limited to a work I co-authored in *The Journal of*

Politics, "Measuring Compactness and the Role of a Compactness Standard in a Test for Partisan and Racial Gerrymandering." Id., Vol. 52, No. 4 (Nov., 1990), pp. 1155-1181 (with Richard G. Niemi, Bernard Grofman, and Carl Carlucci).

14. In that work, my co-authors and I discussed the advantages and limitations of various measures of compactness as well as differing definitions. As we stated in the article, "disputes about compactness will be numerous… there are those who would dismiss it outright as well as those who believe in it passionately." We further noted that "whatever turns out to be its utility as a districting standard, we hope that we have sufficiently clarified the concept so as to stimulate more rational, enlightened discussion of its merits and faults as well as further study of its supposed effects."

15. Both prior and subsequent to my coauthorship of the *Journal of Politics* article, I have regularly advised state legislatures and others regarding the concept of compactness and regarding the compactness of specific districts and districting plans.

SOURCES OF DATA FOR THIS REPORT

16. In compiling the maps, figures and tables for this report, I have accessed current and historic redistricting plan files for multiple states, which I have access to through my present and former consulting work, along with other analyses provided by other redistricting information sources available through counsel. All of the compactness measures have been computed using U. S. Census Bureau's TIGER geographic files which contain multiple levels of census geographic units including, but not limited to, census blocks, voting districts (VTDs), census places, and counties as well as congressional and legislative district boundaries. Current and former political district boundaries are coded into attribute files at the census block level and are commonly

referred to as "block assignment files". The geographic boundary information for legislative plans enacted in the decade prior to, and in the 2010 Decennial Census, is available through U. S. Census Bureau data sources. In some cases actual boundary files for the 1991 Virginia legislative districts have been matched to current census geographic files to "move" block assignments from those generated from prior redistrictings into the current 2010 TIGER geography. I also reviewed the Webster Report which was submitted in the 2001 *Wilkins* trial, and used it as a source of information with regard to district compactness (See Appendix 5).

17. Maptitude for Redistricting allows users to compile reports for 8 different compactness tests (Reock, Schwartzberg, Perimeter, Polsby-Popper, Length-Width, Population Polygon, Population Circle and Ehrenburg). These tests were included in the Maptitude software at the request of leading redistricting experts.

18. Compactness tests are an integral part of modern redistricting geographic information systems (GIS) and are part of many analytical reports which can be produced for redistricting plans drafted on a modern redistricting system. I have used the GIS software developed by Caliper Corporation, located in Newton, Massachusetts. This software package is "Maptitude for Redistricting", and is the most commonly-used software used by redistricting experts across the nation. All the maps used in this report have been produced using Maptitude for Redistricting. The information contained on most of the tables in this report has been compiled from Maptitude reports using Excel, which is a common Microsoft utility spreadsheet software program.

MAKING DETERMINATIONS REGARDING COMPACTNESS

19. Experts in my field are frequently asked by state legislatures or other interested parties to determine whether a map is "compact" under relevant statutory or constitutional provisions. To the best of my knowledge, no state statutes or constitutions define what specific attributes are to be found in a "compact" plan, provide objective tests for measuring the degree to which those attributes are present, or provide numerical, or other objective bright lines, for determining whether plans, or districts, are compact.

20. What is certain is that the Virginia House of Delegates has been given latitude in balancing the constitutional mandate of compactness against other competing criteria in drafting plans. Keeping in mind the Virginia Supreme Court's rulings on the compactness provision in the Virginia Constitution prior to this redistricting cycle, the House of Delegates elected to depend on the Reock and Polsby-Popper compactness tests to determine the required level of compactness for the districts in HB-5005. These are the two tests used by both sides in the *Wilkins* case.

21. Compactness is a concept in search of a definition. This is so for two reasons. First, there is not complete agreement among legislators, courts, experts, scholars or the general public about what attributes must or should be present in a "compact" district or an individual redistricting plan. Second, even when specific attributes of compactness are isolated, there are multiple methods of measuring those attributes and there is no general agreement about which compactness test should be used. Indeed, there is not even agreement on a minimum measurement, or bright line, that should be used for determining whether a given district or plan is compact (i.e. what districts pass from being acceptably compact to being unacceptable).

22. However, various concepts of compactness can be used to evaluate plans for purposes of comparing one plan to another. These varied concepts are reflected in mathematical tests that attempt to measure the presence of certain attributes. For example, some tests focus on the shape of a district, finding different ways to assign a one-dimensional number to a two-dimensional shape. Some tests focus solely on the perimeter of an area, primarily on intrusions or extrusions and not, necessarily, on how well a district fills in a given area. Other tests focus on population dispersion within a district. Each of these tests rewards certain positive attributes of compactness and penalizes negative attributes.

23. The quantitative scores derived from these tests can be used to make comparisons between plans with respect to certain attributes that the "tester" thinks are important, but they should not be used to eliminate plans that fail to meet a predetermined level. There is no score for any one measure, much less for all of them, when used together, that, on its face, indicates unsatisfactory compactness. Compactness scores can be used to rank districts in individual plans along a single continuum, but, once again, it is imperative to note that there is no "bright line" which separates acceptable districts from unacceptable districts.

24. Although some districts may stand out because of unusual geographic shapes, each district must be examined in the context of the entire plan to understand how that district's shape has been caused by the interplay of conflicting redistricting criteria applied by a redistricting authority, especially if the authority is a legislative body.

25. If alternative plans have been offered in the same state, for the same chamber, one must not view comparative compactness between two plans without a thorough examination of all the factors taken into consideration by the plan drafters.

26. Despite the inability to meaningfully use mathematical tests in applications beyond a simple comparison between two plans, compactness is not a meaningless concept. For example, while there is no precise temperature that marks the transition from hot to cold, we know that 10 degrees is uniformly regarded as cold and 90 degrees as warm. The same can be said of 30 degrees and 70 degrees and other temperatures closer to the middle. But, again, there is not agreement on what point marks the crossing from hot to cold.

27. In deciding whether a given set of districts are compact, the question that experts ask is not whether another plan scores lower or higher using a mathematical test to measure some single attribute of compactness. Instead, experts determine whether the plan is "hot" or "cold;" according to the degree it exhibits which differ from the traits of other districting plans that have been determined by legislatures or courts to be compact.

28. For purposes of this report, I have first used two compactness measures which are most familiar to courts and widely cited. They were also used by the Virginia Supreme Court in the *Jamerson* and *Wilkins* decisions[2]. The first test is called the Reock Test and the second is the Polsby-Popper Test. Both tests are based on the geographic area of a district compared to a calculated circle. Both tests are not affected by the geographic size of the district, or districts, which are being measured.

[2] Jamerson v. Womack. 423 S.E. 2d 180, 244 Va, 506 (1992)
Wilkins v. West. 571 S.E. 2d 100m 264 Va. 447 (2002)

29. The Reock Test, sometimes described as "Geographic Dispersion Compactness" computes the ratio of the area of a district to the area of the smallest circle that can enclose the district. A "perfectly shaped district' would be a circle in which the area of the district and the circumscribing circle would be the same. The perfect Reock score would be 1.00. Another common geometrically-shaped district would be a square, with a Reock score of 0.637.

30. The Polsby-Popper Test, sometimes described as "Perimeter Compactness" computes the ratio of the area of a district to the area of a circle with the same perimeter as the district being tested. Once again, a "perfectly shaped" district would be a circle with a score of 1.00. A square-shaped district would have a score of 0.7853.

31. Figure 1 contains examples of three rectangular districts (A, B & C). District A is a square. District B is a rectangle with a width twice as long as its height. District C has a width three times as long as its height. As the rectangle increases in width relative to its height, the Reock score decreases from 0.637 to 0.509 to 0.382. Thus, the Reock test reacts strongly to elongated districts. At the same time, as the rectangle elongates, the Polsby-Popper score decreases from 0.785 to 0.698 to 0.589. The Polsby-Popper score reacts less to the elongation of a district.

32. Figure 2 contains a much more convoluted district with numerous indentations into a basic shape which is almost square. Testing this hypothetical district yields a Reock score of 0.405, but a Polsby-Popper Score of only 0.082, which is much lower. This example illustrates that the Polsby-Popper tests is very sensitive to indentations into the district, or multiple lengthy extrusions. This is the type of geographic feature might be caused by water boundaries, such as coastlines or rivers, other mountain ridges. The

marked difference between the size of the Reock circle and the Polsby-Popper circle is quite striking in this example.

33. Another test is the Schwartzberg Test, which Dr. McDonald has used in his evaluation of HB-5005 for the House of Delegates. The Schwartzberg Test involves a more complex set of calculations. This test computes the ratio of a simplified perimeter of a district to the perimeter of a circle with the same area of as the simplified district. The calculation of the simplified perimeter is extremely sensitive to minor irregularities in a district boundary.[3] Because Maptitude calculates this measure using census block boundaries as the base geographic layer, simplification is very limited, unduly raising the Schwartzberg scores. Figure 3 contains an example of a district used to calculate a Schwartzberg score.

34. Joseph Schwartzberg, in his 1966 paper discussing what is now referred to as the Schwartzberg compact test, was clearly contemplating larger-scale units of geography for computing his test scores. In this case, it was whole counties, which are far less numerous than census blocks.[4]

35. The problem with the Reock, Polsby-Popper and Schwartzberg test is they are computed using geometrical shapes (circles) which would never be found in actual legislative districts. These scores are also compared to unrealistic simplified geometric

[3] A bounding polygon (or district perimeter) consists of series of connected line segments called vertices (or in census geography referred to in Census Bureau terms as "nodes". In the Maptitude simplification calculation each bounding node is established when two census blocks are adjacent to the boundary of a district. Between two adjacent vertices (or nodes) there may, or may not, be a number of straight line segments (called chains) following the boundary of the block. The end points of these line segments in between the node are called shape points. It is only the shape points which are eliminated by the Maptitude Schwartzberg calculation of the simplified perimeter. Even though the shape points are eliminated, using block node points still retains most of the irregularities of a district's perimeter. See Figure 5 for a diagram of this Census Bureau geography.

[4] Schwartzberg, Joseph E., Reapportionment, Gerrymanders, and the Notion of Compactness, 50 Minn. L. Rev.443 1965-1966, Pages 449 through 451 See Appendix 3).

shapes such as squares and rectangles. Almost all legislative districts are created using geographic building blocks, such as census tracts or election precincts, which are often irregular in shape. Because these three compactness tests are based on area and perimeter measurements, they create unrealistic impressions of what constitutes realistic compactness in terms of detecting a possible gerrymander. These compactness scores take no account of location of people (or voters) in the area in which districts are being drawn. Acres and square miles of land do not vote. Adult people do vote.

36. A measurement of district compactness which accounts for the actual location of voters in a district is the Population Polygon Test. It is based on the principle that compactness may also be measured by the way populations are treated or, perhaps mistreated, in district formation. A less compact district often may include widely separated population centers, while bypassing adjacent populations. On the other hand, a district might have a convoluted shape and yet, bypass very few people adjacent to its borders. This may be especially true in rural areas with many small population centers separated by areas of low population densities.

37. In the Population-Polygon test a convex hull is drawn around the district. This is, perhaps, best described as a rubber band enclosing the district's actual boundary shape. Such a district is demonstrated in Figure 4. Thus, the population outside of the district which is located inside the convex hull (or polygon) is determined. The population inside the convex hull is divided into the population of the district. The calculations required for this test are easily handled by today's redistricting systems. Theoretical scores range from 0 to 1, with 1 being the best score. Dr. McDonald cites an article by Richard Niemi as agreeing with his assertion that the use of multiple compactness tests is the better way

of analyzing compactness. He says that the Niemi article is "perhaps the most widely cited academic paper on compactness measures".[5] The Population-Polygon test, along with the 3 compactness tests McDonald uses, is also described in Niemi's paper. I co-authored this paper. The Population-Polygon was not widely used at the time the paper was written because it was more difficult to calculate in the 1980's. That is not an issue today.

38. Another advantage of the Population-Polygon test is that many districts may have compactness scores which closely approach the highest score, which is 1.00. For example, using the Population-Polygon test, the districts along the boundary of a state such as Virginia, are not affected by circles that partially fall outside of the state's boundary. If Virginia were to be a single district, it would have a Population Polygon score of 1.00. I have introduced this compactness test into my analysis to further demonstrate the point that each test highlights different considerations of compactness. This compactness measurement will be used in my discussion below.

39. A rather concise explanation of all the Maptitude compactness tests may be found on pages 117 and 119 of Maptitude's Version 6.0 Supplemental User's Guide. I have included copies of these three pages as Appendix 2 to this report.

40. It is clear that Virginia's House of Delegates districts are quite compact when compared to districts in many other states. If this court wishes to be informed by this information, a full discussion may be found in my *Bethune* declaration.

VIRGINIA SPECIFIC COMPACTNESS ISSUES

[5] Richard Niemi, et al., Measuring Compactness and the Role of a Compactness Standard in a Test for Partisan and Racial Gerrymandering, 52 J. of Politics 1155 (1990)

41. Unfortunately, actual legislative districts cannot be drawn to conform to basic geometric shapes. This is especially true for Virginia, which is irregularly shaped to begin with. Theoretically, states such as Colorado or Wyoming might be divided into square or rectangular districts except that, even in these states, the units of geography, which are the building blocks used to construct districts, are not regularly shaped.

42. Virginia has 7,213 miles of tidal bay frontage, 123 miles of ocean coastline, and 457 miles of on-tidal river frontage. Many county lines follow riverbeds, and the State's western boundary runs along over 400 miles of mountain ridges and rivers. All of these physical features would adversely affect some compactness tests, especially the Polsby-Popper and Schwartzberg tests. There would be an even greater effect on the Schwartzberg test, because Maptitude's calculations do not do a great deal of boundary simplification.

43. Virginia's Tidewater region, which runs from the fall line to the Chesapeake Bay, is divided into four major regions by the James, York and Rappahannock Rivers. The natural boundaries of Virginia's counties in the Tidewater are shaped by these rivers which were historic avenues of transportation in Virginia, and also affect district compactness.

44. Other factors affecting district shapes are the federal constitutional requirement of equality of population and the requirements of the Federal Voting Rights Act of 1965, as amended. Areas of minority population may not be located in geographic configurations which lend to their inclusion in optimally-compact districts. A state redistricting authority might have to balance other competing redistricting goals against the shapes of

districts to draft feasible plans. In Virginia, the Legislature has been afforded considerable latitude in making these policy decisions by the State Supreme Court.

45. The protection of incumbency interests and preservation of district core areas from one redistricting plan to another also comes into play. This criterion, combined with the policy of minimizing precinct splits, also cause less compact districts. This is equally true for African-American districts. In my 50 years of redistricting experience, I have found that most incumbents are unlikely to happily exchange safe districts for more competitive districts, and that also includes minority incumbents.

46. Relative shifts in the balance of population between areas of a state require difficult policy choices. The overriding factor in creating a new Virginia districting plan is that the map must be enacted by the same legislators who will represent the new districts. If enough legislators do not accept the map, there will be no plan enacted.

COMPACTNESS AND THE VIRGINIA COURTS

47. There is no clear national standard or bright line test with which to determine that Virginia's current districts meet some theoretical academic standard of permissible compactness. However, Virginia does have a state constitutional provision on compactness. There are two state Supreme Court decisions which provide considerable guidance and define how Virginia constitution compactness requirement applies to the General Assembly's redistricting process. These standards were cited by the House of Delegates as part of their 2011 redistricting criteria (See *Jamerson* and *Wilkins*). The General Assembly is given wide latitude in balancing compactness with other redistricting criteria.. While I leave the legal implications of these cases for the attorneys,

it is instructive to examine the redistricting compactness score of districts previously approved by the Virginia Supreme Court.

48. In *Jamerson*, the Virginia Supreme Court upheld the chancellor's court's determination that the reapportionment of Senatorial Districts 15 and 18, as enacted in Chapter 18 of the Acts of the 1991 Special session of the General Assembly (Code §§ 24, 1-17, 19 and 22), did not violate Article II, §6 of the Virginia Constitution with regard to compactness. Map 3 shows 1991 Senate Districts 15 and 18. Table 2 contains the Reock, Polsby Popper and Schwartzberg test scores for those same districts. It is important to note that Senate District 15 was not a majority-minority district and the shape of District 15 was not caused by the location of District 18 which was a majority-minority district.

49. The Virginia Supreme Court further concluded that proper deference must be given to the wide discretion accorded to the General Assembly in its value judgment of the relative degree of compactness required when reconciling the multiple concerns of apportionment.

50. The Court further stated in *Jamerson* that if the determination of an issue is fairly debatable, the legislative determinations will be upheld in court. This is certainly the case when debating the constitutionality of the compactness of HB-5005.

51. The multiple concerns of apportionment were enumerated in Joint Resolution No 1, approved by the House Committee on Privileges and Elections of March 25, 2011, were enumerated as: population equality, voting rights, contiguity and compactness, single-member districts and community of interest. "Incumbency considerations" were included in the community of interest criterion. This would include preservation, to the

extent possible, of core district populations and avoidance of pairing of incumbents in the districts in a new map. These interests have been widely noted by courts as legitimate concerns which a legislature may consider when drafting redistricting plans.

52. Both *Jamerson* and *Wilkins* mirror the complaint in this case with respect to compactness. In *Wilkins*, the circuit court found for the plaintiffs and determined that some districts did not meet the Virginia Constitution's requirements for compactness and contiguity and found that several of the districts were racially gerrymandered. The Virginia Supreme Court unanimously reversed, finding that all the districts complied with the Virginia Constitution with regard to compactness.

53. The *Jamerson* and *Wilkins* standard, allowing the General Assembly to balance other redistricting factors against compactness is clearly satisfied by the evidence cited below. I measured the compactness of all the districts in the 1991 2001 and 2011 State Senate and House of Delegates Plans[6]. Table 1 contains the minimum, maximum and mean scores for all six plans as well as the standard deviation for each test. There are clearly no significant quantifiable differences in these scores for each chamber's maps for the last three redistrictings. It follows, therefore, that if the compactness scores of the HB-5005 are not significantly different from the scores accepted by the Virginia Supreme Court in *Jamerson* and *Wilkins*, then they are compact enough to pass muster under the Virginia Constitution.

54. Table 10 lists all the districts that plaintiffs challenged with respect to compactness or contiguity in either *Jamerson* or *Wilkins*. It lists the both the Reock and Polsby-Popper compactness scores for all districts. It should be noted that only one of

[6] The 1991 Senate and House of Delegates Plans were reconstructed from geographic shape files containing the boundaries of the districts. They were converted to 2010 census blocks in order to run compactness tests using Maptitude for Redistricting.

the 2011 House of Delegates districts has a compactness score lower that the 28 districts which were the subject of compactness complaints in either *Jamerson* or *Wilkins*. House of Delegates District 72 does fall slightly below on the Polsby-Popper score, but it is significantly above on the Reock score.

55. Pildes and Niemi, in their 1993 paper, which commented extensively on compactness of congressional districts, asserted that districts would be considered "relatively low" in compactness if they had a Reock score equal to or less than 0.15 OR a Polsby-Popper score equal to or less than 0.05[7]. Of the 33 challenged districts in *Jamerson*, *Wilkins* or this case, only one district falls into that "relatively low" compactness category suggested in the Pildes paper. That is 1991 Senate Plan District 18, with a Reock score of 0.12. Not one of the challenged HB-5005 districts falls into this category. House of Delegates District 72, mentioned above, is above the scores which Pildes and Niemi find to be "relatively low".

56. In order to give the court a frame of reference in the *Bethune* case, I determined the compactness scores for other Southern states which face the same issues of minority representation versus compactness. This is included in my April 10, 2015 declaration. This court may find it helpful to view these districts, although they are not directly comparable to Virginia House of Delegates redistricting plans (see Appendix 4).

VIRGINIA'S DISTRICTS ARE CLEARLY CONTIGUOUS

57. No districts cross the wide tidal estuaries of the James, York and Rappahannock Rivers and the only crossing of the Chesapeake Bay is from Northampton County to

[7] Pildes, Richard H. and Niemi, Richard G, *Expressive Harms, "Bizarre Districts," and Voting Rights: Evaluating Election-District Appearances after Shaw v. Reno*, 92 Mich. L. Rev. 483 1993-1994, pages 564 and 565.

Norfolk City, which is required to give District 100 enough population (34,484) to bring it up to the ideal district population.

58. I will not further discuss the issue of district contiguity any further except to say that my 50 years of redistricting experience across the nation give me good perspective of contiguity issue. My opinion is that all the HB-5005 districts in this case are contiguous by accepted national standards and, particularly, by Virginia standards.

DOCTOR MCDONALD'S TWO ALTERNATIVE PLANS

59. Plaintiffs' expert, Dr. McDonald has drafted two sample plans for each chamber of the General Assembly. In this report, I am only concerned with the 2 alternative plans for the House of Delegates, which I refer to as McDonald-1 and McDonald-2. Using these two plans he draws the unsubstantiated that the General Assembly's illegitimate use of some of what he describes as "optional criteria" is responsible for lack of compactness complained about by Plaintiffs. He also draws the unsubstantial claim that drafting districts with populations deviation of plus or minus 1% causes decreased conformity to the Virginia State Constitution's redistricting criteria of voting rights, population equality and compactness, a point which is not conclusively demonstrated. In essence, Dr. McDonald's premise that too much emphasis on preservation of district core areas and creation of districts reasonably favorable to incumbent preservation is the cause of insufficient district compactness in HB-5005.

60. Both McDonald plans conform to the 1% population deviation standard adopted by the House of Delegates. Both Plans use the same 12 majority-minority districts (African-American). These majority African American districts are 63, 69, 70, 71, 74, 75, 77, 80, 88, 90, 92, and 95. McDonald-1 also has 3 additional districts which contain over

99% of the population contained in the equivalent HB-5005 districts. They are Districts 79, 91 and 100. McDonald-2 contains 8 non-minority districts that contain at least 98% of the population as the equivalent HB-5005 districts. They are Districts 1, 64, 76, 79, 83, 91, 94 and 100. All other districts in both McDonald plans are significantly altered. Maps 1-A. 1-B, 2-A and 2-B show the locations of these unchanged or insignificantly-changed districts, except for District 1ocated in the southwest corner of the state. These are all located in the southeast corner of the state.

61. Additionally, both of McDonald's alternative plans for the House of Delegates are improperly constructed to act as proper comparisons to establish conclusions as to HB-5005's lack of conformity to the Virginia State Constitution's compactness requirements. These plans are wholesale redraws of HB-5005.

62. A competent map drawer can draft a map that better adheres to any given criterion so long as he is allowed to alter the balance of the consideration of other legitimate criteria. But such a map is of little to no probative value in a situation in which the House of Delegates has struck a balance between several, competing, legitimate concerns. Such a map is merely a replacement of the map drawer's judgment of that balance over that of the House of Delegates.

63. Furthermore, Dr. McDonald overlooks an important achievement of HB-5005, the near political consensus, and high degree of bipartisan support which that HB-5005 received. It is clear that Dr. McDonald's redistricting scheme would have not have achieved such widespread support. Given his lack of concern for core retention and avoiding incumbent parings, particularly in McDonald-1. Also, as was indicated by testimony during the *Bethune* trial, many legitimate concerns such as the location of a

legislator's place of business, smaller communities of interest and other legitimate concerns that are often known only to legislators and their constituents cannot be replicated by an outside map drafter. The fact that these issues were considered and included in HB-5005 would be critical to the achievement of the near-consensus achieved for HB-5005. Because of my 50 years of experience, I clearly understand the importance of these factors. Dr, McDonald's alterative maps demonstrate that he ascribes little value to this balancing of interest by the House of Delegates.

64. The Maptitude software generates a report called "core constituencies". One can print out a report which lists what percentages of the old districts' populations were distributed into each new district; which I refer to as core distribution. Conversely, one can print out a second report which lists what percentage of each new district's' population came from each of the old districts, which I refer to as core composition. I have used core composition analyses in this report because this measurement better describes the population origins of each new district in relation to the district it supplants. Of course, the characteristics of the cores from the old district retained in each new district is highly subjective and difficult, if not impossible, to quantify. This is part of the "reconciliation of multiple concerns" which the Virginia Supreme Court mentioned in *Jamerson*.

65. Tables 3, 4 and 5 address the quantifiable component of core composition of HB-5005, McDonald-1 and McDonald 2.

66. Table 3 shows the portions of each HB-5005 districts that was in the corresponding 2001 Plan district. For all 100 HB-5005 Plan districts, the average core

composition rate was 67.12%. For the 80 districts, which are not the same in both the McDonald-2 Plan and HB-5005, the average core composition rate is 66.51%.

67. Table 4 shows the portions of each McDonald-1 Plan district that was in the corresponding 2001 Plan district. For all 100 McDonald-1 Plan districts, the average core composition rate was 57.16%. For the 85 districts, which are not the same in both HB-5005 and the McDonald-1 Plan, the average core composition rate is 55.09%.

68. Table 5 shows the portions of each McDonald-2 Plan district that was in the corresponding 2001 Plan district. For all 100 McDonald-2 Plan districts, the average core composition rate was 57.52%. For the 80 districts, which are not the same in both HB-5005 and the McDonald-2 Plan, the average core composition rate is 54.43%.

69. Setting aside the districts which are the same between for HB-5005 and the two McDonald plans, the district core composition rates for HB-5005, McDonald-1 and McDonald-2 are 66.51%, 55.09% and 54.43% respectively. This means the districts in the two McDonald plan districts contain significantly less population taken from their corresponding 2001 Plan district compared to HB-5005.

70. Another important analysis is to determine the degree to which the two McDonald alternative plans differ from HB-5005. Since HB-5005 passed with a high level of bipartisan support, the balancing between district compactness and the other criteria used by the House of Delegates was sufficiently satisfactory to satisfy a super-majority of the House of Delegates. Therefore, it is helpful to see how much McDonald-1 and McDonald-2 differ in population composition from HB-5005. This can be partially answered by core composition percentages between HB-5005 and the two McDonald Plans.

71. Tables 6 and 7 show the core composition averages between the two McDonald plans and HB-5005. For all 100 districts in McDonald-1, Table-6 indicates a 59.00% core composition rate for McDonald-1 compared to HB-5005. For the 85 districts in McDonald-1 which are not essentially the same in both plans, the core composition rate is 51.78%. For all 100 districts in McDonald-2, Table-7 indicates a 54.79% core composition rate for McDonald-2 compared to HB-5005. For the 80 districts in McDonald-2 which are not essentially the same in both plans, the core composition rate is 43.55%. This indicates a low rate of overlap between HB-5005's districts and the two McDonald sample plans' districts. The two alternative maps have scrambled the districts contained in HB-5005.

72. An example of Dr. McDonald's gratuitous scrambling of HB-5005's districts in McDonald-2 can be found on Map-1B. This is an enlargement of the James River-Chesapeake Bay Tidewater Area in southeast Virginia. The districts shaded yellow and green on this map are exactly the same in McDonald-2 and HB-5005. As this map indicates, the six white-shaded districts (generally located in Chesapeake City and Virginia Beach) are completely bounded by the yellow and green shaded districts ss well as by the Atlantic Ocean (Districts 22, 78, 81, 82, 84 and 85). As these districts are actually quite compact, there was no reason to change the configuration of this district as they were drawn in HB-5005 in McDonald-2. However, each one of these districts was altered in McDonald-2. The only effect of these changes would be, perhaps, a very slight gain in the average compactness score in Dr. McDonald's plan.

73. Briefly put, both McDonald alternative maps fail to demonstrate that, while still meeting all of the House of Delegate's redistricting criteria, an alternative map has been

presented which can meet some, as yet-to-be defined, compactness standard that would satisfy the Plaintiffs' issues with HB-5005. Because of the dismal core composition scores of McDonald's two alternative maps in comparison to HB-5005, these alternatives fail because they are, essentially, wholesale redraws of the HB-5005. They decimate the HB-5005 population cores. McDonald-1 further fails by admittedly disregarding incumbent residences, as well as the choices the House of Delegates made as to which incumbents should be paired.

PLAINTIFFS FAIL TO ESTABLISH A BRIGHT-LINE COMPACTNESS STANDARD

74. Dr. McDonald, relying on the Niemi paper, is prepared to testify that "the most complete measure of compactness is found by using multiple individual measures."(See page 9-of the McDonald Report) What is not mentioned is that Niemi paper also states that quantitative scores should be used for comparisons and not to eliminate plans (Niemi 1176). Because there are a large number of compactness tests one may select, any single test or combination of tests leads to differing conclusions regarding the degree of compactness in any given plan. Dr. McDonald has selected a combination of three tests, Reock, Polsby-Popper and Schwartzberg to draw his conclusions. But it is fairly debatable that other tests or combination of tests could also be used. There is not a bright line score for each test that indicates when a single district is below an acceptable compactness level. Even if there were such a theoretical bright line, each compactness test would, most certainly, have a different point on the continuum of a score from 1.00 to 0.00, at which the ranking of district scores from 1.00 (highest compactness) to 0.00 in which a score would move from acceptable to unacceptable. It is also true that both the

highest and lowest scores are not attainable for districts in actual plans, particularly when perfection is a simple geometric shape, such as a circle or square. For this reason, it is questionable to use a simple average of multiple test score to determine when a plan's slips from compactness to non-compactness. It is quite like mixing one pound apples with one and a half pound oranges.

75. Using Maptitude, I have created a group of tables (8A through 8J) using four different compactness tests (Reock, Polsby-Popper, Schwartzberg and Population-Polygon). I have also calculated percentile scores (expressed in decimals) for these four test results by assigning score of 1.00 to the highest scoring district and 0.00 to the lowest scoring district. All other district scores fall into a percentile range between these two scores. These tables are sorted by each different test's percentile scores to rank the districts in order by level of measured compactness. This examination will clearly demonstrate the uncertainty of using quantitative compactness scores alone to determine the constitutionality of a plan's districts.

76. The Tables 8-A to 8-J use three colors shadings to indicate three classifications of districts in HB-5005. Green shading indicates the 12 districts which Dr. McDonald did not change from their HB-5005 configurations because they were majority-minority district. Red shading indicates the 5 HB-5005 districts which Plaintiffs assert are in violation of Virginia's constitutional compactness standard. All of the remaining 83 districts are shaded white. Each table has a number of white-shaded districts (district which are not VRA districts or not a district about which Plaintiffs complained) which falls between the highest scoring red district and the lowest scoring district (i.e. less compact than a district about which Plaintiffs complained). Table 9 lists the actual

districts and districts numbers in the white classification which have compactness scores for each compactness test or combination of tests, which are lower than the highest scoring of Plaintiffs 5 districts.

77. For example, looking at Table 8-B (sorted by Reock score percentile) on the second page and 8 rows down, one will find HB-5005 District 88. It is the highest scoring district about which Plaintiffs complained. There are 21 districts in HB-5005, which are not majority districts with lower compactness scores which are not the subject of Plaintiffs' complaint. Table 9 lists those district numbers.

78. The point of this ranking exercise is that Plaintiffs selection of the 5 districts listed in their complaint is very subjective and fairly debatable which districts could have been subject to a complaint by Plaintiffs, if, indeed, any districts at all. This is especially true for District 17 which appears in all 9 tables with a lower compactness score than the highest ranking of Plaintiffs 5 objectionable districts. One might suspect that there is some unspoken motivation for leaving District 17 out of the complaint.

79. I also debate Dr. McDonald's use of two perimeters tests (Polsby-Popper and Schwartzberg) in conjunction with one dispersion test (Reock). This overemphasizes one set of compactness traits over another. I also prefer using percentile scores as they are not affected by the unrealistic high-end scores which can only be attained by drawing districts shaped like basic geometric figures such as squares or circles. In each compactness measurement the highest score receives a percentile of 1.00 and the lowest 0.0 (This could also be represented by 100% or 0%).

CONCLUSIONS

80. I conclude the following from my study.

81. Dr. McDonald has failed to present an alternative plan that clearly demonstrates that it would satisfy the House of Delegates' redistricting objectives and still result in significantly better compactness scores.

82. The two alternative districts presented by Dr. McDonald are not suitable for comparison to HB-5005. Dr. McDonald has substituted his own vision of what Virginia's House of Delegates districts should look like in place of the districts resulting from the General Assembly's process of balancing compactness against its other criteria.

83. In McDonald-2, Dr. McDonald has closely matched the number of pairings and splits communities of interest. This, however, is a quantitative decision rather than a qualitative decision, once again, ignoring the choices of the House of Delegates.

84. Dr. McDonald has not established any bright line score, or average of scores, which indicated non-compliance with the Virginia Constitution.

85. There is clearly reasonable debate about which compactness tests, or combination of tests, may be used to evaluate HB-5005's level of compactness.

86. Dr. McDonald has substituted his own determination of what compactness tests should be used to evaluate HB-5005 in place of the compactness test used by the House of Delegates of the courts.

87. The General Assembly clearly has the authority to redistrict the state's legislative districts and balance all of the competing interests involved against the constitutional requirement of compactness.

88. If the specific standards determining compactness compliance were clearly determined, it would not be difficult to "game" the drawing process to comply. Unfortunately clearly determined standards do not exist.

I declare under penalty of perjury that the foregoing is true and correct.

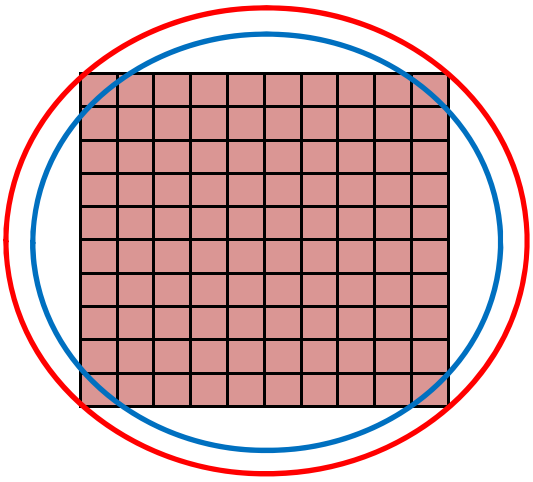
Executed this 18th day of January, 2017

Thomas Brooks Hofeller, Ph.D.

FIGURE 1

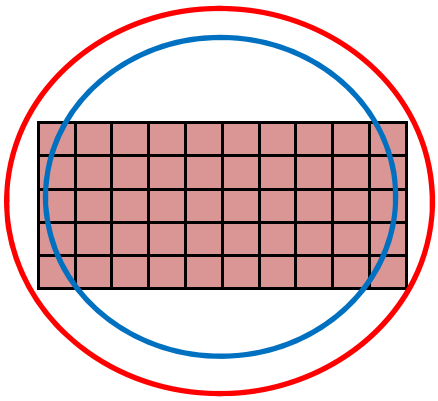
HYPOTHETICAL LEGISLATIVE DISTRICTS A, B & C

Showing Reock and Polsby Circles



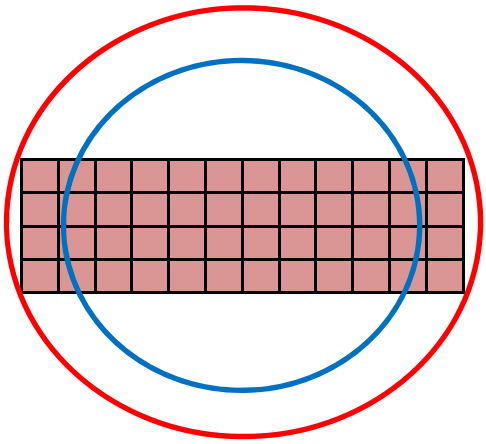
DISTRICT A

Reock Circle is Red. Reock Score is 0.6367
Polsby-Popper Circle is Blue. Polsby-Popper Score is 0.7853



DISTRICT B

Reock Circle is Red. Reock Score is 0.509
Polsby-Popper Circle is Blue. Polsby-Popper Score is 0.698



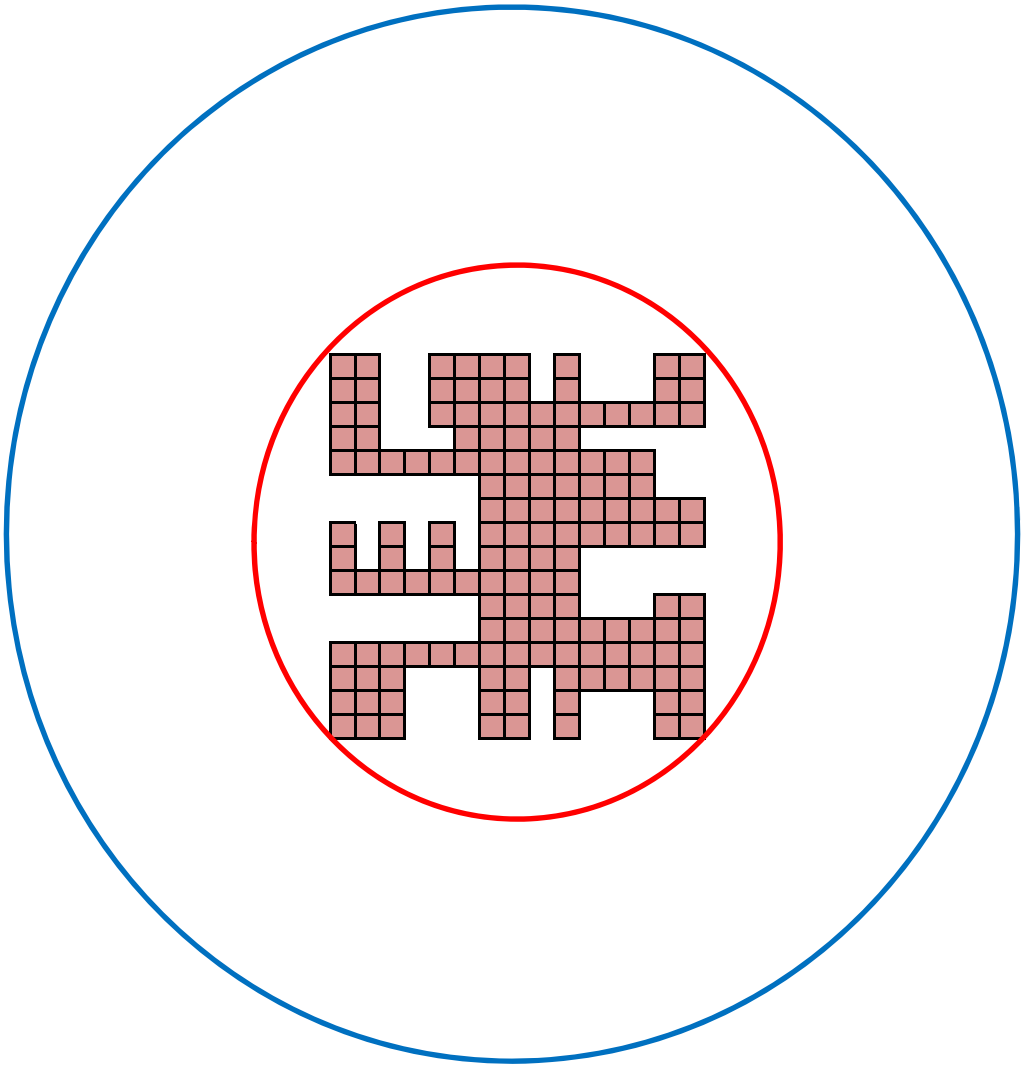
DISTRICT C

Reock Circle is Red. Reock Score is 0.380
Polsby-Popper Circle is Blue. Polsby-Popper Score is 0.589

FIGURE 2

HYPOTHETICAL LEGISLATIVE DISTRICT D

Showing Reock and Polsby Circles



Reock Circle is Red. Reock Score is .405

Polsby-Popper Circle is Blue Polsby-Popper Score is .082

FIGURE 4

Example of Population Polygon Compactness Test

The score is the population of the district divided by the population inside the convex hull.

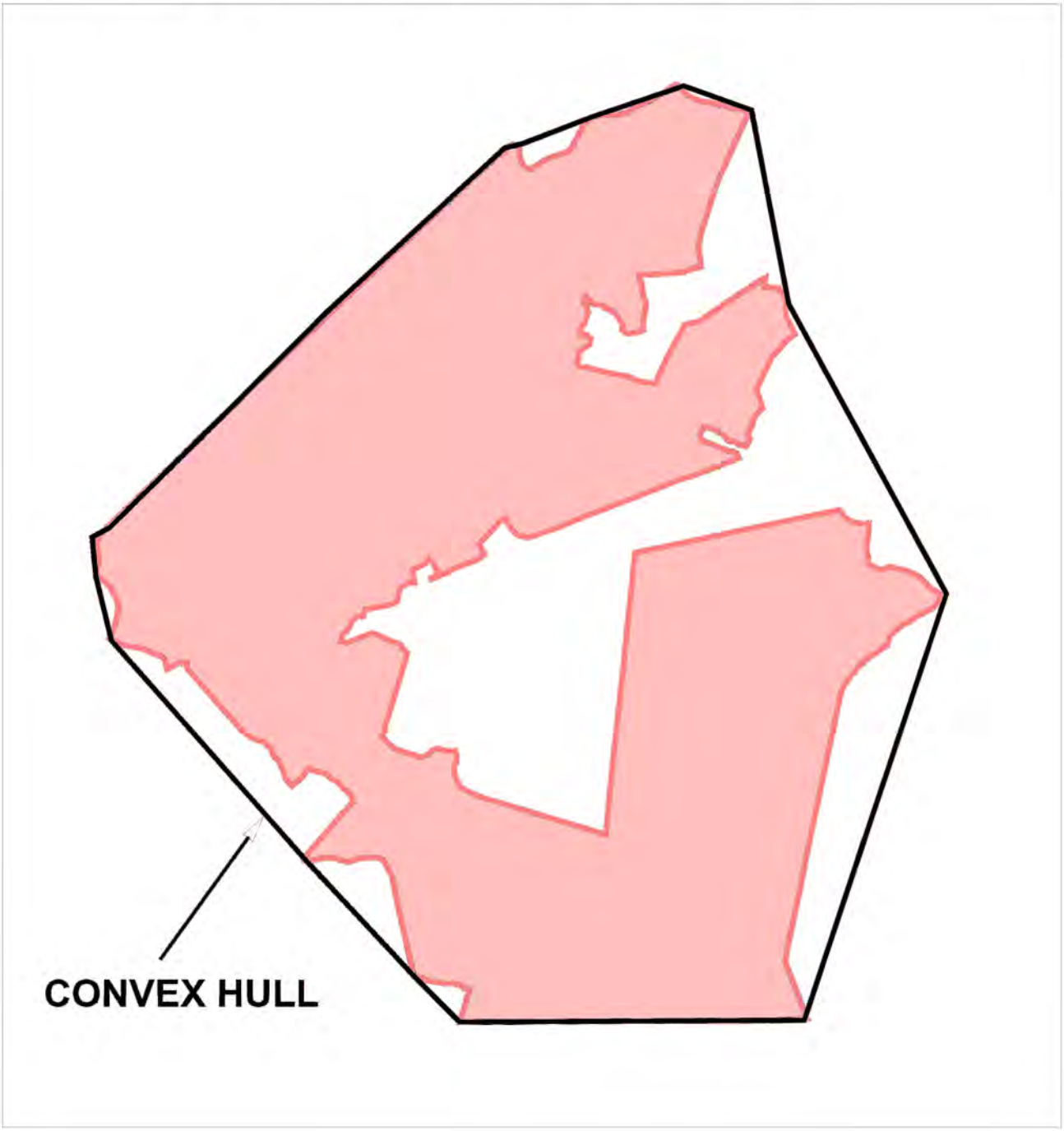
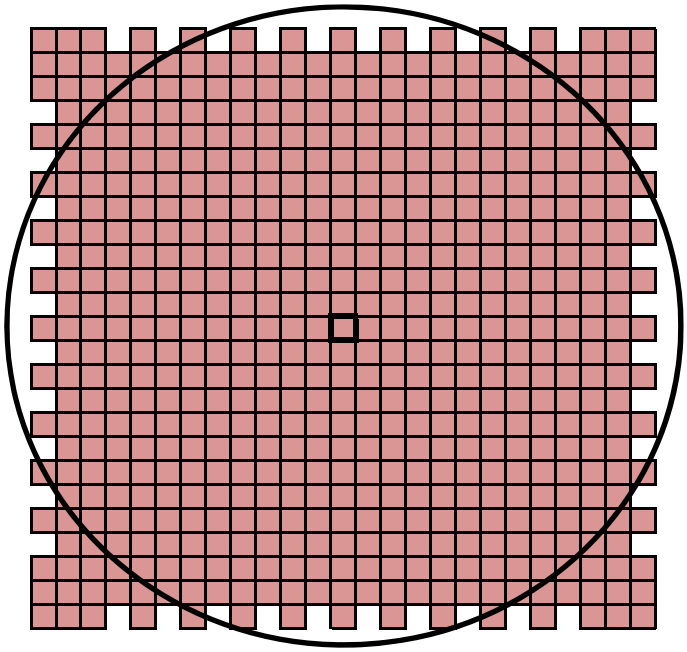


FIGURE 3

HYPOTHETICAL LEGISLATIVE DISTRICT D

Showing Schwartzberg Circles

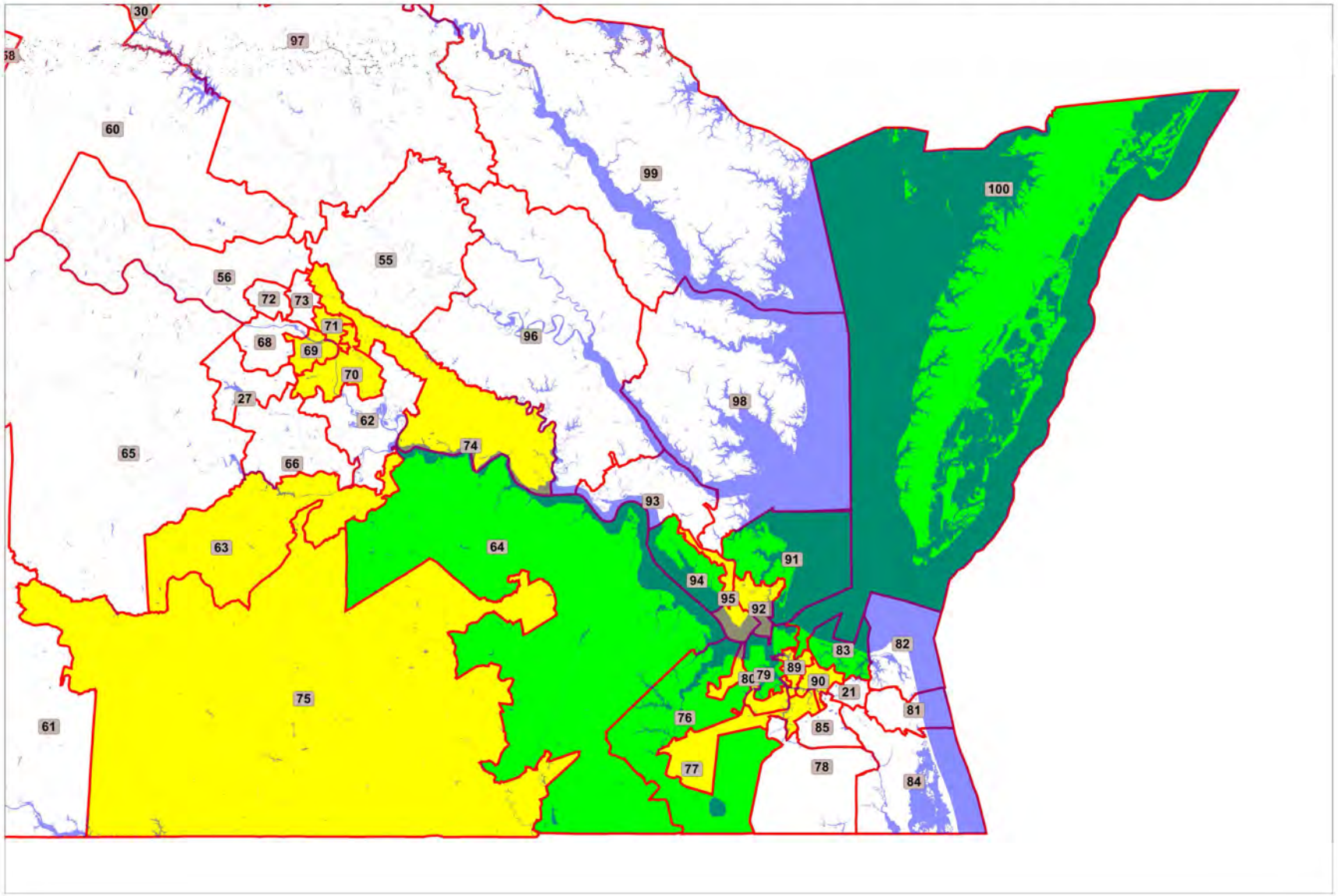


Schwartzberg Circle is Black. Schwartzberg Score is 2.12

Reock Score is .58 **Polsby-Popper Score is .22**

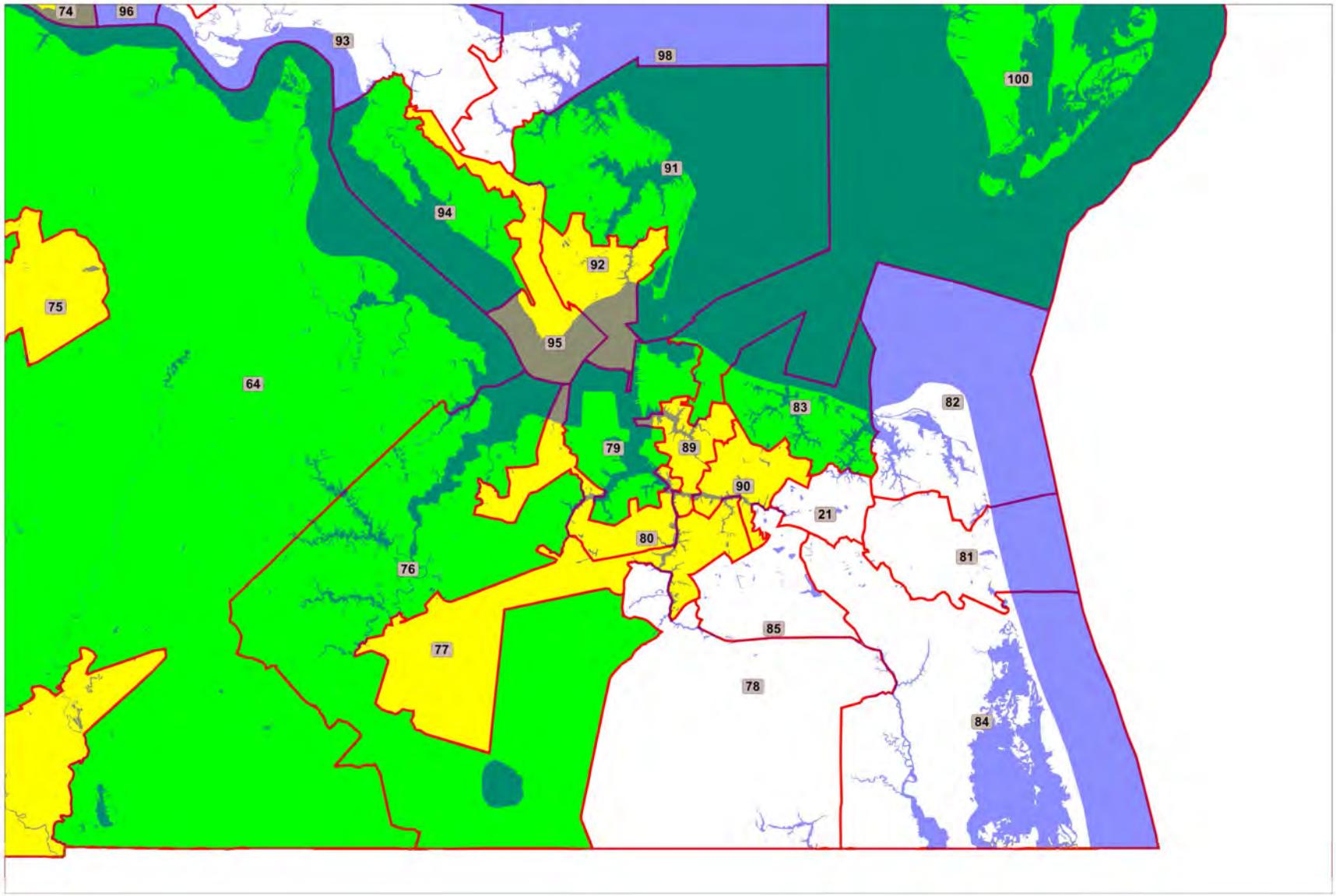
MAP 1-A

Districts the Same in McDonald-2 and 2011 Enacted House Plan



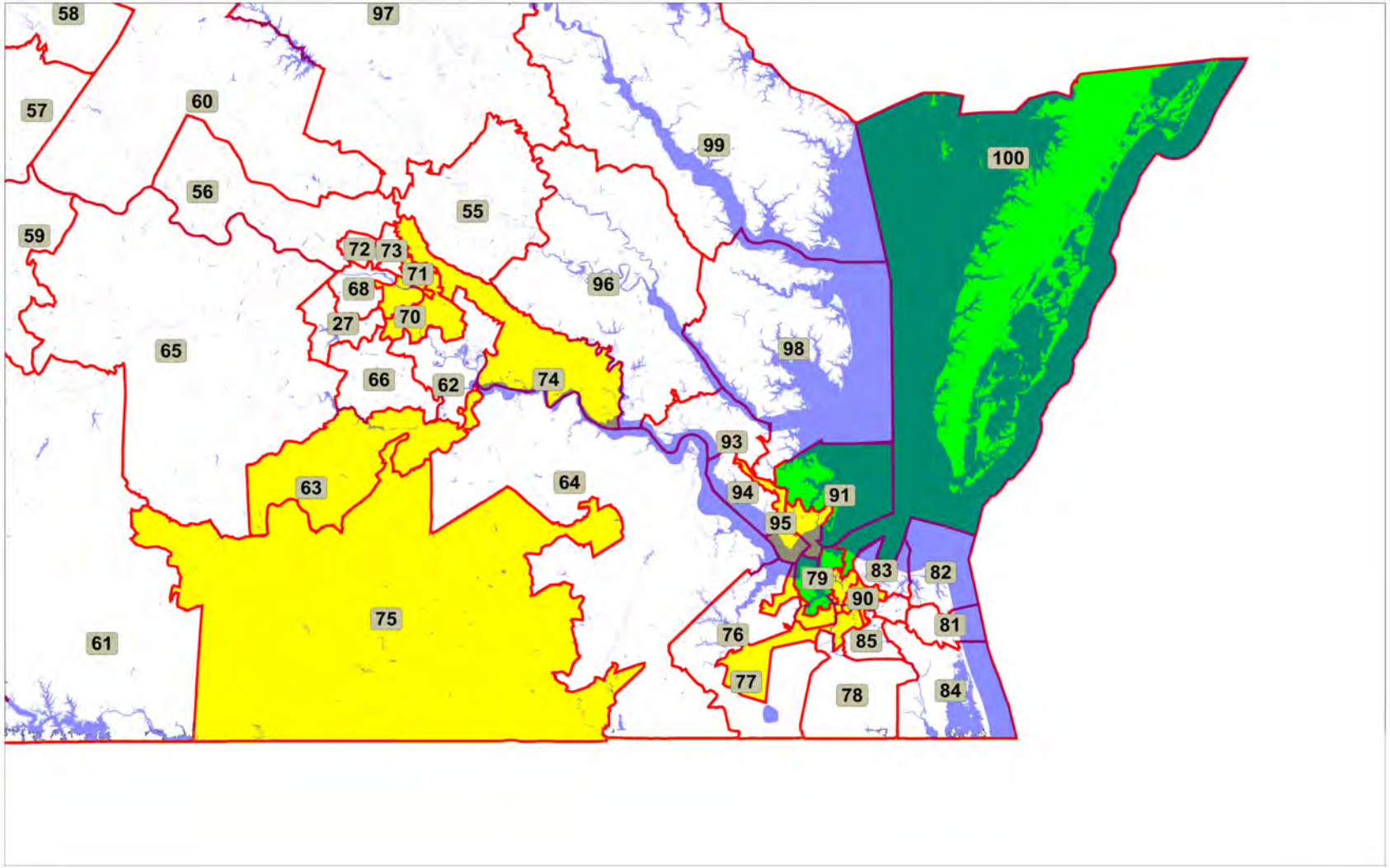
MAP 1-B

Districts the Same in McDonald-2 and 2011 Enacted House Plan



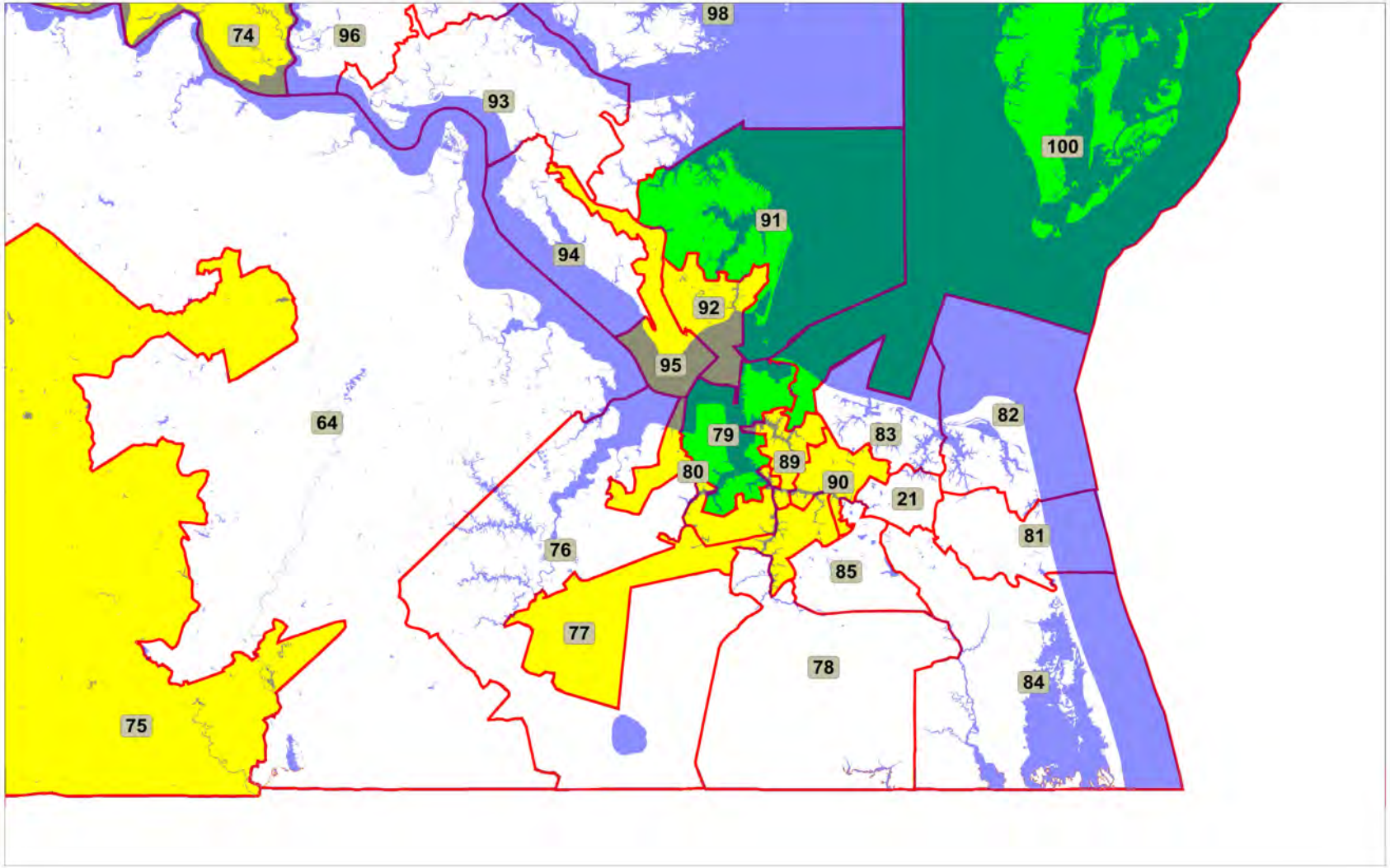
MAP 2-A

Districts More Than 99 the Same in McDonald -1 and HB-5005



MAP 2-B

Districts More Than 99 the Same in McDonald -1 and HB-5005



MAP 3
1991 State Senate Districts
Senate Districts 15 & 18

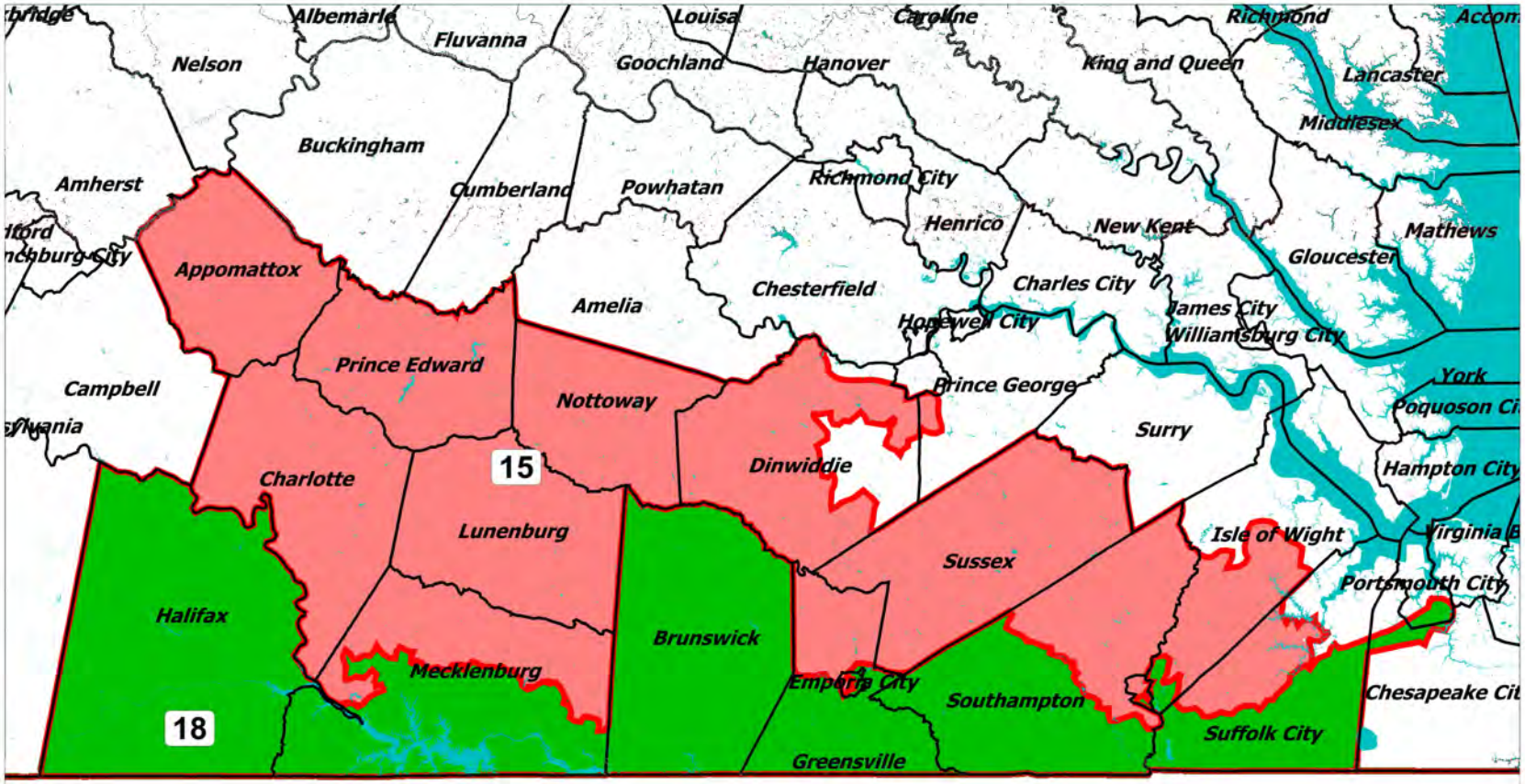


TABLE 1

VIRGINIA HOUSE AND SENATE COMPACTNESS 1991, 2001 AND 2011

Showing Reock and Polsby-Popper Scores

Redistricting Plan	Reock				Polsby-Popper			
	Minimum	Maximum	Mean	Std. Dev.	Minimum	Maximum	Mean	Std. Dev.
1991 House	0.14	0.61	0.37	0.11	0.07	0.60	0.25	0.10
2001 House	0.16	0.61	0.38	0.10	0.10	0.58	0.26	0.10
2011 House	0.14	0.62	0.36	0.11	0.08	0.55	0.24	0.09
1991 Senate	0.12	0.63	0.36	0.11	0.09	0.43	0.24	0.10
2001 Senate	0.14	0.54	0.36	0.10	0.13	0.41	0.24	0.08
2011 Senate	0.14	0.46	0.27	0.08	0.08	0.39	0.16	0.06

Source: United States Census Bureau 2010 Redistricting Data TIGER File.

TABLE 2

1991 State Senate Districts

Compactness Score for District Contested in *Jamerson*

Senate District	Reock	Schwartzberg	Polsby-Popper
15	0.23	2.86	0.10
18	0.12	3.01	0.10

TABLE 3 (Rev.)

Percentage of HB-5005 District from 2001 District

Core Composition

HB-5005 District Number	Group (See Below)	Percentage of HB-5005 District from 2001 District
1	y	78.79
2		-
3		79.81
4		21.97
5		36.06
6		17.05
7		52.71
8		71.76
9		57.90
10		-
11		80.68
12		51.08
13		55.98
14		81.49
15		81.90
16		71.47
17		69.06
18		59.22
19		69.15
20		55.03
21		68.77
22		50.33
23		68.04
24		75.65
25		60.19
26		96.34
27		48.40
28		84.12
29		68.93
30		96.69
31		68.56
32		87.65
33		74.32
34		53.98
35		67.55
36		77.68
37		53.62
38		53.01
39		58.44

HB-5005 District Number	Group (See Below)	Percentage of HB-5005 District from 2001 District
40		80.42
41		69.82
42		78.87
43		74.65
44		86.34
45		74.03
46		87.94
47		80.88
48		69.20
49		50.99
50		58.40
51		66.09
52		34.51
53		76.07
54		100.00
55		63.44
56		93.97
57		82.49
58		83.37
59		61.35
60		86.10
61		81.91
62		58.65
63	x	80.20
64	y	56.20
65		78.05
66		87.43
67		90.57
68		65.45
69	x	74.70
70	x	67.31
71	x	78.31
72		51.53
73		49.89
74	x	80.08
75	x	78.64
76	y	93.25
77	x	74.40
78		94.48
79	y	42.35
80	x	59.94
81		67.37
82		71.08

HB-5005 District Number	Group (See Below)	Percentage of HB-5005 District from 2001 District
83	y	52.01
84		75.83
85		60.22
86		73.13
87		-
88		59.00
89	x	76.86
90	x	63.21
91	y	61.66
92	x	77.27
93		51.43
94	y	76.26
95	x	62.15
96		65.56
97		60.95
98		94.97
99		100.00
100	y	56.91
Avg. All 100 Districts		67.12
Avg. Districts changed more than 2% (80)		66.51

Group Type:	**White = McDonald-2 districts changed more than 2% from HB-5005 districts (80)** **Yellow = Non-Minority McDonal-2 districts changed less than 2% from HB-5005 districts (8)** **Green = Minority McDonal-2 districts unchanged from HB-5005 districts (12)**

TABLE 4 (Rev.)

Percentage of McDonald-1 District from 2001 District

Core Composition

McDonald-1 District Number	Group (See Below)	Percentage of McDonald-1 District from 2001 District
1		71.01
2		-
3		60.80
4		63.08
5		53.12
6		15.25
7		50.29
8		56.84
9		61.11
10		48.52
11		73.98
12		56.27
13		67.28
14		40.11
15		76.95
16		44.61
17		19.77
18		47.43
19		58.31
20		11.33
21		41.47
22		61.68
23		64.14
24		48.12
25		52.32
26		83.59
27		41.39
28		62.48
29		96.65
30		96.24
31		62.63
32		78.40
33		100.00
34		51.60
35		-
36		58.49
37		53.29
38		49.11
39		49.79

McDonald-1 District Number	Group (See Below)	Percentage of McDonald-1 District from 2001 District
40		58.23
41		45.99
42		42.19
43		46.03
44		86.75
45		71.92
46		66.48
47		33.85
48		66.74
49		-
50		77.51
51		39.69
52		84.84
53		54.69
54		87.74
55		62.05
56		62.13
57		63.72
58		63.82
59		69.43
60		-
61		62.09
62		45.99
63	x	80.20
64		56.14
65		65.57
66		54.33
67		56.88
68		56.63
69	x	74.70
70	x	67.31
71	x	78.31
72		49.29
73		61.23
74	x	80.08
75	x	78.64
76		90.86
77	x	74.40
78		60.52
79	y	42.35
80	x	59.94
81		47.78
82		78.03

McDonald-1 District Number	Group (See Below)	Percentage of McDonald-1 District from 2001 District
83		51.76
84		44.67
85		56.61
86		31.88
87		-
88		53.67
89	x	76.86
90	x	63.21
91	y	61.24
92	x	77.27
93		45.72
94		76.58
95	x	62.15
96		46.46
97		55.43
98		61.14
99		62.46
100	y	56.66
Avg. All 100 Districts		57.16
Avg. Districts changed more than 1% (85)		55.09

Group Type:

White = McDonald-1 districts changed more than 1% from HB-5005 districts (85)

Yellow = Non-Minority McDonal-1 districts changed less than 1% from HB-5005 districts (3)

Green = Minority McDonal-1 districts unchanged from HB-5005 districts (12)

TABLE 5 (Rev.)

Percentage McDonald-2 District from 2001 District

Core Composition

McDonald-2 Plan District Number	Group (See Below)	Percentage McDonald-2 District from 2001 District
1	y	79.95
2		61.81
3		-
4		84.26
5		58.13
6		20.16
7		43.31
8		21.30
9		51.84
10		55.74
11		68.05
12		52.13
13		91.59
14		39.99
15		78.22
16		50.46
17		37.16
18		54.80
19		72.70
20		61.53
21		41.98
22		73.08
23		94.11
24		-
25		44.08
26		62.68
27		46.20
28		69.21
29		69.57
30		100.00
31		33.45
32		47.13
33		100.00
34		69.80
35		49.81
36		64.10
37		64.45
38		55.65
39		64.10
40		84.13

McDonald-2 Plan District Number	Group (See Below)	Percentage McDonald-2 District from 2001 District
41		57.09
42		22.90
43		42.63
44		61.30
45		66.51
46		63.84
47		48.49
48		53.31
49		47.86
50		94.63
51		76.31
52		70.62
53		-
54		66.27
55		65.49
56		59.74
57		63.31
58		56.40
59		48.95
60		-
61		51.41
62		56.64
63	x	80.20
64	y	56.20
65		38.19
66		72.91
67		11.28
68		59.47
69	x	74.70
70	x	67.31
71	x	79.31
72		63.69
73		63.80
74	x	80.08
75	x	78.64
76	y	93.25
77	x	74.40
78		55.30
79	y	42.35
80	x	59.94
81		50.30
82		81.76
83	y	52.72
84		31.87

McDonald-2 Plan District Number	Group (See Below)	Percentage McDonald-2 District from 2001 District
85		43.42
86		37.58
87		-
88		56.93
89	x	78.86
90	x	63.21
91	y	60.58
92	x	77.27
93		43.35
94	y	76.59
95	x	62.15
96		47.41
97		36.06
98		68.72
99		82.12
100	y	59.91
Avg. All 100 Districts		57.52
Avg. Districts changed more than 2% (80)		54.43

Group Type:

White = McDonald-2 districts changed more than 2% from HB-5005 districts (80)

Yellow = Non-Minority McDonal-2 districts changed less than 2% from HB-5005 districts (8)

Green = Minority McDonal-2 districts unchanged from HB-5005 districts (12)

TABLE 6 (Rev)

Percentage of McDonald-1 District from HB-5005

Core Composition

McDonald-1 District Number	Group (See Below)	Percentage of McDonald-1 District from HB-5005
1		92.20
2		35.39
3		58.44
4		51.42
5		25.12
6		28.77
7		50.29
8		52.56
9		38.31
10		-
11		81.27
12		57.41
13		44.60
14		51.98
15		87.58
16		52.61
17		28.48
18		24.58
19		35.18
20		-
21		64.09
22		21.32
23		47.77
24		59.84
25		22.32
26		79.42
27		78.53
28		44.20
29		70.95
30		90.41
31		45.06
32		83.83
33		53.47
34		25.23
35		-
36		57.92
37		72.04
38		46.54
39		14.69
40		42.47

McDonald-1 District Number	Group (See Below)	Percentage of McDonald-1 District from HB-5005
41		54.22
42		26.57
43		40.28
44		89.66
45		73.70
46		62.73
47		17.71
48		53.83
49		-
50		48.80
51		11.19
52		38.88
53		60.06
54		69.79
55		59.31
56		49.96
57		68.93
58		56.54
59		55.68
60		-
61		67.22
62		60.32
63	x	100.00
64		90.92
65		62.44
66		49.72
67		52.99
68		78.55
69	x	100.00
70	x	100.00
71	x	100.00
72		46.48
73		63.88
74	x	100.00
75	x	100.00
76		88.76
77	x	100.00
78		66.11
79	y	100.00
80	x	100.00
81		32.71
82		87.96
83		96.66
84		44.88

McDonald-1 District Number	Group (See Below)	Percentage of McDonald-1 District from HB-5005
85		81.39
86		13.17
87		3.74
88		38.17
89	x	100.00
90	x	100.00
91	y	99.33
92	x	100.00
93		58.17
94		96.66
95	x	100.00
96		61.34
97		81.71
98		61.14
99		62.35
100	y	99.55
Avg. All 100 Districts		59.00
Avg. Districts Changed more than 1% (85)		51.78

Group Type:

White = McDonald-1 districts changed more than 1% from HB-5005 districts (85)

Yellow = Non-Minority McDonal-1 districts changed less than 1% from HB-5005 districts (3)

Green = Minority McDonal-1 districts unchanged from HB-5005 districts (12)

TABLE 7 (Rev.)

Percentage of McDonald-2 District from HB-5005

Core Composition

McDonald-2 District Number	Group (See Below)	Percentage of McDonald-2 District from HB-5005
1	y	100.00
2		-
3		-
4		37.88
5		27.97
6		25.20
7		49.23
8		16.62
9		38.84
10		-
11		60.25
12		49.93
13		59.66
14		47.56
15		78.19
16		47.90
17		29.58
18		73.38
19		46.90
20		46.44
21		17.80
22		26.12
23		70.28
24		-
25		14.07
26		62.68
27		53.61
28		49.97
29		81.52
30		84.03
31		7.54
32		-
33		54.18
34		43.40
35		46.08
36		64.10
37		64.71
38		37.89
39		37.78

McDonald-2 District Number	Group (See Below)	Percentage of McDonald-2 District from HB-5005
40		64.22
41		42.18
42		25.31
43		50.46
44		58.88
45		74.73
46		63.84
47		55.88
48		25.09
49		53.25
50		62.86
51		60.65
52		20.57
53		-
54		50.36
55		27.05
56		47.07
57		76.42
58		50.79
59		39.14
60		-
61		54.47
62		86.65
63	x	100.00
64	y	100.00
65		38.19
66		72.64
67		11.27
68		63.20
69	x	100.00
70	x	100.00
71	x	100.00
72		43.77
73		32.51
74	x	100.00
75	x	100.00
76	y	100.00
77	x	100.00
78		57.22
79	y	100.00
80	x	100.00
81		26.22
82		82.27

McDonald-2 District Number	Group (See Below)	Percentage of McDonald-2 District from HB-5005
83	y	98.51
84		34.86
85		27.17
86		33.53
87		3.52
88		22.92
89	x	100.00
90	x	100.00
91	y	98.25
92	x	100.00
93		82.20
94	y	98.64
95	x	100.00
96		62.16
97		-
98		66.72
99		82.12
100	y	100.00
Avg. All 100 Districts		54.79
Avg. Districts changed more than 2% (80)		43.55

Group Type:

White = McDonald-2 districts changed more than 2% from HB-5005 Districts (80)

Yellow = Non-Minority McDonal-2 districts change more more than 2% from HB-5005 districts (8)

Green = Minority McDonal-2 districts unchanged from HB-5005 districts (12)

TABLE 8-A

Virginia 2011 Enacted House of Delegates Redistricting Plan (HB-5005)

Data on Four Measures of Compactness

Sorted by District Number

	Reock	Polsby-Popper	Schwartz-berg	Popula- tion Polygon
Min	0.14	0.08	1.28	0.19
Max	0.62	0.55	3.35	0.96
Mean	0.36	0.24	2.00	0.64
Std. Dev.	0.11	0.09	0.35	0.16

District	Compactness Score				Distance from Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartz berg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
1	0.26	0.30	1.69	0.91	0.1244	0.2257	1.6658	0.7185	0.26	0.47	0.80	0.93	0.51	0.62	0.36	0.53	0.87
2	0.30	0.18	2.17	0.39	0.1626	0.1016	1.1879	0.1966	0.34	0.21	0.57	0.25	0.37	0.34	0.27	0.45	0.41
3	0.28	0.21	1.84	0.93	0.1440	0.1373	1.5150	0.7363	0.30	0.29	0.73	0.95	0.44	0.57	0.29	0.51	0.84
4	0.49	0.20	1.97	0.66	0.3455	0.1217	1.3868	0.4693	0.71	0.25	0.67	0.61	0.55	0.56	0.48	0.69	0.64
5	0.19	0.17	2.29	0.65	0.0547	0.0913	1.0595	0.4560	0.11	0.19	0.51	0.59	0.27	0.35	0.15	0.31	0.55
6	0.27	0.26	1.82	0.75	0.1259	0.1825	1.5311	0.5561	0.26	0.38	0.74	0.72	0.46	0.52	0.32	0.50	0.73
7	0.50	0.25	1.81	0.61	0.3578	0.1760	1.5439	0.4227	0.74	0.37	0.74	0.55	0.62	0.60	0.55	0.74	0.65
8	0.47	0.26	1.83	0.42	0.3263	0.1832	1.5196	0.2269	0.68	0.38	0.73	0.29	0.60	0.52	0.53	0.70	0.51
9	0.35	0.24	1.83	0.58	0.2129	0.1654	1.5261	0.3917	0.44	0.35	0.74	0.51	0.51	0.51	0.39	0.59	0.62
10	0.23	0.18	2.16	0.47	0.0935	0.1077	1.1890	0.2788	0.19	0.23	0.57	0.36	0.33	0.34	0.21	0.38	0.47
11	0.59	0.26	1.80	0.83	0.4483	0.1857	1.5555	0.6381	0.93	0.39	0.75	0.83	0.69	0.72	0.66	0.84	0.79
12	0.39	0.22	1.95	0.72	0.2486	0.1399	1.4052	0.5256	0.51	0.29	0.68	0.68	0.49	0.54	0.40	0.60	0.68
13	0.16	0.13	2.53	0.48	0.0167	0.0569	0.8214	0.2922	0.03	0.12	0.40	0.38	0.18	0.23	0.08	0.22	0.39
14	0.24	0.16	2.34	0.76	0.0972	0.0829	1.0180	0.5682	0.20	0.17	0.49	0.74	0.29	0.40	0.19	0.35	0.61
15	0.55	0.34	1.52	0.83	0.4072	0.2587	1.8350	0.6339	0.84	0.54	0.88	0.82	0.76	0.77	0.69	0.86	0.85
16	0.36	0.18	2.11	0.65	0.2254	0.1062	1.2462	0.4559	0.47	0.22	0.60	0.59	0.43	0.47	0.34	0.53	0.60
17	0.25	0.09	2.95	0.41	0.1087	0.0171	0.4067	0.2152	0.22	0.04	0.20	0.28	0.15	0.18	0.13	0.21	0.24
18	0.62	0.24	1.92	0.62	0.4787	0.1594	1.4285	0.4322	0.99	0.33	0.69	0.56	0.67	0.64	0.66	0.84	0.62
19	0.43	0.17	2.09	0.52	0.2919	0.0931	1.2642	0.3302	0.60	0.19	0.61	0.43	0.47	0.46	0.40	0.61	0.52
20	0.27	0.15	2.28	0.65	0.1313	0.0784	1.0725	0.4545	0.27	0.16	0.52	0.59	0.32	0.39	0.22	0.39	0.55
21	0.42	0.31	1.74	0.68	0.2825	0.2335	1.6085	0.4919	0.58	0.49	0.78	0.64	0.62	0.62	0.54	0.68	0.71
22	0.20	0.11	2.59	0.50	0.0623	0.0299	0.7662	0.3030	0.13	0.06	0.37	0.39	0.19	0.24	0.10	0.25	0.38
23	0.26	0.15	2.25	0.58	0.1171	0.0756	1.0994	0.3904	0.24	0.16	0.53	0.51	0.31	0.36	0.20	0.39	0.52
24	0.44	0.25	1.78	0.78	0.3038	0.1711	1.5727	0.5845	0.63	0.36	0.76	0.76	0.58	0.63	0.49	0.69	0.76
25	0.26	0.18	2.14	0.51	0.1217	0.1048	1.2094	0.3132	0.25	0.22	0.58	0.41	0.35	0.36	0.24	0.42	0.49

District	Compactness Score				Distance from Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
26	0.46	0.36	1.57	0.85	0.3182	0.2872	1.7839	0.6575	0.66	0.60	0.86	0.85	0.71	0.74	0.63	0.76	0.86
27	0.35	0.25	1.92	0.70	0.2062	0.1769	1.4291	0.5120	0.43	0.37	0.69	0.66	0.49	0.54	0.40	0.56	0.68
28	0.39	0.26	1.82	0.75	0.2481	0.1803	1.5285	0.5569	0.51	0.38	0.74	0.72	0.54	0.59	0.44	0.62	0.73
29	0.36	0.21	1.98	0.62	0.2160	0.1355	1.3685	0.4322	0.45	0.28	0.66	0.56	0.46	0.49	0.37	0.55	0.61
30	0.53	0.36	1.49	0.83	0.3937	0.2882	1.8639	0.6345	0.81	0.60	0.90	0.82	0.77	0.78	0.71	0.86	0.86
31	0.38	0.19	2.11	0.59	0.2428	0.1182	1.2433	0.3996	0.50	0.25	0.60	0.52	0.45	0.47	0.37	0.55	0.56
32	0.46	0.31	1.64	0.89	0.3196	0.2320	1.7100	0.6950	0.66	0.48	0.82	0.90	0.66	0.72	0.57	0.74	0.86
33	0.33	0.23	1.89	0.71	0.1880	0.1572	1.4599	0.5156	0.39	0.33	0.70	0.67	0.47	0.52	0.36	0.55	0.69
34	0.24	0.22	1.91	0.62	0.1036	0.1414	1.4430	0.4231	0.21	0.30	0.70	0.55	0.40	0.44	0.25	0.45	0.62
35	0.20	0.19	2.11	0.70	0.0609	0.1183	1.2446	0.5110	0.13	0.25	0.60	0.66	0.32	0.41	0.19	0.36	0.63
36	0.43	0.30	1.66	0.76	0.2875	0.2280	1.6885	0.5706	0.59	0.48	0.81	0.74	0.63	0.66	0.54	0.70	0.78
37	0.18	0.18	2.24	0.62	0.0391	0.1033	1.1159	0.4245	0.08	0.22	0.54	0.55	0.28	0.35	0.15	0.31	0.54
38	0.62	0.45	1.44	0.84	0.4834	0.3778	1.9093	0.6430	1.00	0.79	0.92	0.83	0.90	0.89	0.89	0.96	0.88
39	0.35	0.19	2.16	0.50	0.2095	0.1129	1.1904	0.3097	0.43	0.24	0.57	0.40	0.41	0.41	0.33	0.50	0.49
40	0.26	0.17	2.20	0.35	0.1175	0.0935	1.1548	0.1613	0.24	0.20	0.56	0.21	0.33	0.30	0.22	0.40	0.38
41	0.36	0.32	1.72	0.75	0.2184	0.2443	1.6348	0.5531	0.45	0.51	0.79	0.72	0.58	0.62	0.48	0.62	0.75
42	0.35	0.20	2.09	0.36	0.2123	0.1200	1.2607	0.1688	0.44	0.25	0.61	0.22	0.43	0.38	0.35	0.52	0.41
43	0.22	0.21	2.10	0.72	0.0807	0.1330	1.2501	0.5323	0.17	0.28	0.60	0.69	0.35	0.43	0.22	0.38	0.65
44	0.43	0.32	1.69	0.87	0.2915	0.2411	1.6626	0.6757	0.60	0.50	0.80	0.87	0.64	0.70	0.55	0.70	0.84
45	0.29	0.26	1.81	0.73	0.1544	0.1806	1.5425	0.5406	0.32	0.38	0.74	0.70	0.48	0.54	0.35	0.53	0.72
46	0.52	0.55	1.28	0.94	0.3771	0.4785	2.0752	0.7507	0.78	1.00	1.00	0.97	0.93	0.94	0.89	0.89	0.99
47	0.41	0.33	1.73	0.76	0.2720	0.2514	1.6265	0.5684	0.56	0.53	0.78	0.74	0.62	0.65	0.54	0.67	0.76
48	0.18	0.16	2.24	0.44	0.0372	0.0798	1.1100	0.2432	0.08	0.17	0.53	0.31	0.26	0.27	0.12	0.31	0.42
49	0.24	0.16	2.35	0.70	0.1026	0.0878	1.0004	0.5056	0.21	0.18	0.48	0.65	0.29	0.38	0.20	0.35	0.57
50	0.46	0.34	1.62	0.77	0.3178	0.2643	1.7371	0.5808	0.66	0.55	0.84	0.75	0.68	0.70	0.60	0.75	0.79
51	0.24	0.18	2.15	0.53	0.0969	0.1049	1.2046	0.3329	0.20	0.22	0.58	0.43	0.33	0.36	0.21	0.39	0.51
52	0.23	0.25	1.92	0.61	0.0930	0.1772	1.4290	0.4181	0.19	0.37	0.69	0.54	0.42	0.45	0.28	0.44	0.61
53	0.46	0.34	1.69	0.77	0.3174	0.2588	1.6609	0.5742	0.66	0.54	0.80	0.74	0.67	0.69	0.60	0.73	0.77
54	0.47	0.25	1.89	0.71	0.3266	0.1773	1.4625	0.5214	0.68	0.37	0.70	0.68	0.58	0.61	0.52	0.69	0.69
55	0.57	0.28	1.69	0.66	0.4291	0.2078	1.6616	0.4718	0.89	0.43	0.80	0.61	0.71	0.68	0.66	0.84	0.71
56	0.34	0.22	1.99	0.51	0.1982	0.1460	1.3609	0.3136	0.41	0.31	0.66	0.41	0.46	0.44	0.36	0.53	0.53
57	0.45	0.41	1.47	0.96	0.3143	0.3304	1.8815	0.7724	0.65	0.69	0.91	1.00	0.75	0.81	0.67	0.78	0.95
58	0.32	0.19	2.11	0.40	0.1842	0.1137	1.2447	0.2088	0.38	0.24	0.60	0.27	0.41	0.37	0.31	0.49	0.44
59	0.30	0.21	1.98	0.39	0.1621	0.1351	1.3756	0.1985	0.34	0.28	0.66	0.26	0.43	0.38	0.31	0.50	0.46
60	0.38	0.31	1.62	0.77	0.2411	0.2370	1.7332	0.5736	0.50	0.50	0.84	0.74	0.61	0.64	0.50	0.67	0.79
61	0.32	0.17	2.21	0.63	0.1787	0.0948	1.1456	0.4419	0.37	0.20	0.55	0.57	0.37	0.42	0.28	0.46	0.56
62	0.36	0.13	2.55	0.38	0.2223	0.0499	0.8038	0.1862	0.46	0.10	0.39	0.24	0.32	0.30	0.28	0.42	0.31

District	Compactness Score				Distance from Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
63	0.25	0.16	2.31	0.63	0.1101	0.0828	1.0481	0.4416	0.23	0.17	0.51	0.57	0.30	0.37	0.20	0.37	0.54
64	0.37	0.16	2.37	0.42	0.2303	0.0803	0.9830	0.2247	0.48	0.17	0.47	0.29	0.37	0.35	0.32	0.48	0.38
65	0.37	0.27	1.82	0.77	0.2286	0.1937	1.5345	0.5810	0.47	0.40	0.74	0.75	0.54	0.59	0.44	0.61	0.75
66	0.31	0.27	1.79	0.74	0.1715	0.1913	1.5618	0.5496	0.35	0.40	0.75	0.71	0.50	0.55	0.38	0.55	0.73
67	0.32	0.25	1.84	0.77	0.1809	0.1757	1.5148	0.5734	0.37	0.37	0.73	0.74	0.49	0.55	0.37	0.55	0.74
68	0.36	0.25	1.97	0.70	0.2171	0.1700	1.3865	0.5102	0.45	0.36	0.67	0.66	0.49	0.53	0.40	0.56	0.66
69	0.52	0.34	1.68	0.85	0.3799	0.2646	1.6749	0.6579	0.79	0.55	0.81	0.85	0.72	0.75	0.67	0.80	0.83
70	0.40	0.19	2.19	0.53	0.2610	0.1142	1.1598	0.3350	0.54	0.24	0.56	0.43	0.45	0.44	0.39	0.55	0.50
71	0.33	0.24	1.99	0.77	0.1933	0.1627	1.3660	0.5798	0.40	0.34	0.66	0.75	0.47	0.54	0.37	0.53	0.70
72	0.26	0.08	3.35	0.45	0.1197	-	-	0.2553	0.25	-	-	0.33	0.08	0.14	0.12	0.12	0.17
73	0.39	0.15	2.51	0.61	0.2476	0.0714	0.8411	0.4161	0.51	0.15	0.41	0.54	0.36	0.40	0.33	0.46	0.47
74	0.16	0.12	2.26	0.40	0.0238	0.0477	1.0932	0.2118	0.05	0.10	0.53	0.27	0.23	0.24	0.07	0.29	0.40
75	0.41	0.19	2.14	0.61	0.2708	0.1157	1.2165	0.4168	0.56	0.24	0.59	0.54	0.46	0.48	0.40	0.57	0.56
76	0.48	0.17	2.37	0.43	0.3429	0.0919	0.9790	0.2347	0.71	0.19	0.47	0.30	0.46	0.42	0.45	0.59	0.39
77	0.19	0.15	2.49	0.52	0.0480	0.0784	0.8599	0.3252	0.10	0.16	0.41	0.42	0.23	0.27	0.13	0.26	0.42
78	0.46	0.35	1.65	0.77	0.3198	0.2778	1.7061	0.5762	0.66	0.58	0.82	0.75	0.69	0.70	0.62	0.74	0.78
79	0.45	0.26	1.84	0.63	0.3121	0.1816	1.5142	0.4398	0.65	0.38	0.73	0.57	0.58	0.58	0.51	0.69	0.65
80	0.26	0.11	2.92	0.53	0.1184	0.0308	0.4366	0.3399	0.24	0.06	0.21	0.44	0.17	0.24	0.15	0.23	0.33
81	0.40	0.23	2.01	0.19	0.2565	0.1502	1.3437	-	0.53	0.31	0.65	-	0.50	0.37	0.42	0.59	0.32
82	0.57	0.45	1.48	0.72	0.4312	0.3704	1.8781	0.5238	0.89	0.77	0.91	0.68	0.86	0.81	0.83	0.90	0.79
83	0.52	0.34	1.69	0.84	0.3769	0.2663	1.6624	0.6479	0.78	0.56	0.80	0.84	0.71	0.74	0.67	0.79	0.82
84	0.44	0.26	1.89	0.75	0.2999	0.1808	1.4640	0.5564	0.62	0.38	0.71	0.72	0.57	0.61	0.50	0.66	0.71
85	0.40	0.24	1.98	0.60	0.2602	0.1652	1.3713	0.4124	0.54	0.35	0.66	0.53	0.51	0.52	0.44	0.60	0.60
86	0.35	0.25	1.98	0.61	0.2128	0.1720	1.3776	0.4167	0.44	0.36	0.66	0.54	0.49	0.50	0.40	0.55	0.60
87	0.22	0.17	2.30	0.62	0.0782	0.0905	1.0546	0.4232	0.16	0.19	0.51	0.55	0.29	0.35	0.18	0.33	0.53
88	0.28	0.13	2.56	0.44	0.1372	0.0509	0.7958	0.2511	0.28	0.11	0.38	0.33	0.26	0.27	0.20	0.33	0.35
89	0.40	0.20	2.21	0.70	0.2570	0.1189	1.1477	0.5062	0.53	0.25	0.55	0.66	0.44	0.50	0.39	0.54	0.60
90	0.46	0.20	2.17	0.65	0.3156	0.1263	1.1877	0.4580	0.65	0.26	0.57	0.59	0.50	0.52	0.46	0.61	0.58
91	0.60	0.47	1.45	0.58	0.4582	0.3930	1.9052	0.3848	0.95	0.82	0.92	0.50	0.90	0.80	0.88	0.93	0.71
92	0.34	0.26	1.89	0.71	0.1969	0.1813	1.4621	0.5214	0.41	0.38	0.70	0.68	0.50	0.54	0.39	0.56	0.69
93	0.22	0.16	2.42	0.54	0.0808	0.0790	0.9307	0.3449	0.17	0.17	0.45	0.45	0.26	0.31	0.17	0.31	0.45
94	0.35	0.38	1.57	0.66	0.2138	0.3049	1.7857	0.4652	0.44	0.64	0.86	0.60	0.65	0.64	0.54	0.65	0.73
95	0.14	0.14	2.61	0.43	-	0.0652	0.7384	0.2358	-	0.14	0.36	0.31	0.16	0.20	0.07	0.18	0.33
96	0.20	0.17	2.19	0.51	0.0647	0.0986	1.1642	0.3169	0.13	0.21	0.56	0.41	0.30	0.33	0.17	0.35	0.49
97	0.43	0.21	1.73	0.85	0.2856	0.1343	1.6267	0.6558	0.59	0.28	0.78	0.85	0.55	0.63	0.44	0.69	0.82
98	0.28	0.26	1.78	0.78	0.1402	0.1858	1.5760	0.5837	0.29	0.39	0.76	0.76	0.48	0.55	0.34	0.52	0.76
99	0.27	0.21	1.97	0.82	0.1286	0.1355	1.3822	0.6320	0.27	0.28	0.67	0.82	0.41	0.51	0.27	0.47	0.74

District	Compactness Score				Distance from Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
100	0.28	0.37	1.56	0.64	0.1402	0.2916	1.7884	0.4443	0.29	0.61	0.86	0.58	0.59	0.58	0.45	0.58	0.72

Districts Challenged for Lack of Compactness

District with a Majority of Adult African-American Population

Sorce: United States Census Bureau, 2011 TIGER File and 2010 Redistricting Data File

TABLE 8-B

Virginia 2011 Enacted House of Delegates Redistricting Plan (HB-5005)

Data on Four Measures of Compactness

Sorted by Reock Percentile - High to Low

	Reock	Polsby-Popper	Schwartz-berg	Popula- tion Polygon
Min	0.14	0.08	1.28	0.19
Max	0.62	0.55	3.35	0.96
Mean	0.36	0.24	2.00	0.64
Std. Dev.	0.11	0.09	0.35	0.16

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartz berg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
38	0.62	0.45	1.44	0.84	0.4834	0.3778	1.9093	0.6430	1.00	0.79	0.92	0.83	0.90	0.89	0.89	0.96	0.88
18	0.62	0.24	1.92	0.62	0.4787	0.1594	1.4285	0.4322	0.99	0.33	0.69	0.56	0.67	0.64	0.66	0.84	0.62
91	0.60	0.47	1.45	0.58	0.4582	0.3930	1.9052	0.3848	0.95	0.82	0.92	0.50	0.90	0.80	0.88	0.93	0.71
11	0.59	0.26	1.80	0.83	0.4483	0.1857	1.5555	0.6381	0.93	0.39	0.75	0.83	0.69	0.72	0.66	0.84	0.79
82	0.57	0.45	1.48	0.72	0.4312	0.3704	1.8781	0.5238	0.89	0.77	0.91	0.68	0.86	0.81	0.83	0.90	0.79
55	0.57	0.28	1.69	0.66	0.4291	0.2078	1.6616	0.4718	0.89	0.43	0.80	0.61	0.71	0.68	0.66	0.84	0.71
15	0.55	0.34	1.52	0.83	0.4072	0.2587	1.8350	0.6339	0.84	0.54	0.88	0.82	0.76	0.77	0.69	0.86	0.85
30	0.53	0.36	1.49	0.83	0.3937	0.2882	1.8639	0.6345	0.81	0.60	0.90	0.82	0.77	0.78	0.71	0.86	0.86
69	0.52	0.34	1.68	0.85	0.3799	0.2646	1.6749	0.6579	0.79	0.55	0.81	0.85	0.72	0.75	0.67	0.80	0.83
46	0.52	0.55	1.28	0.94	0.3771	0.4785	2.0752	0.7507	0.78	1.00	1.00	0.97	0.93	0.94	0.89	0.89	0.99
83	0.52	0.34	1.69	0.84	0.3769	0.2663	1.6624	0.6479	0.78	0.56	0.80	0.84	0.71	0.74	0.67	0.79	0.82
7	0.50	0.25	1.81	0.61	0.3578	0.1760	1.5439	0.4227	0.74	0.37	0.74	0.55	0.62	0.60	0.55	0.74	0.65
4	0.49	0.20	1.97	0.66	0.3455	0.1217	1.3868	0.4693	0.71	0.25	0.67	0.61	0.55	0.56	0.48	0.69	0.64
76	0.48	0.17	2.37	0.43	0.3429	0.0919	0.9790	0.2347	0.71	0.19	0.47	0.30	0.46	0.42	0.45	0.59	0.39
54	0.47	0.25	1.89	0.71	0.3266	0.1773	1.4625	0.5214	0.68	0.37	0.70	0.68	0.58	0.61	0.52	0.69	0.69
8	0.47	0.26	1.83	0.42	0.3263	0.1832	1.5196	0.2269	0.68	0.38	0.73	0.29	0.60	0.52	0.53	0.70	0.51
78	0.46	0.35	1.65	0.77	0.3198	0.2778	1.7061	0.5762	0.66	0.58	0.82	0.75	0.69	0.70	0.62	0.74	0.78
32	0.46	0.31	1.64	0.89	0.3196	0.2320	1.7100	0.6950	0.66	0.48	0.82	0.90	0.66	0.72	0.57	0.74	0.86
26	0.46	0.36	1.57	0.85	0.3182	0.2872	1.7839	0.6575	0.66	0.60	0.86	0.85	0.71	0.74	0.63	0.76	0.86
50	0.46	0.34	1.62	0.77	0.3178	0.2643	1.7371	0.5808	0.66	0.55	0.84	0.75	0.68	0.70	0.60	0.75	0.79
53	0.46	0.34	1.69	0.77	0.3174	0.2588	1.6609	0.5742	0.66	0.54	0.80	0.74	0.67	0.69	0.60	0.73	0.77
90	0.46	0.20	2.17	0.65	0.3156	0.1263	1.1877	0.4580	0.65	0.26	0.57	0.59	0.50	0.52	0.46	0.61	0.58
57	0.45	0.41	1.47	0.96	0.3143	0.3304	1.8815	0.7724	0.65	0.69	0.91	1.00	0.75	0.81	0.67	0.78	0.95
79	0.45	0.26	1.84	0.63	0.3121	0.1816	1.5142	0.4398	0.65	0.38	0.73	0.57	0.58	0.58	0.51	0.69	0.65
24	0.44	0.25	1.78	0.78	0.3038	0.1711	1.5727	0.5845	0.63	0.36	0.76	0.76	0.58	0.63	0.49	0.69	0.76

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
84	0.44	0.26	1.89	0.75	0.2999	0.1808	1.4640	0.5564	0.62	0.38	0.71	0.72	0.57	0.61	0.50	0.66	0.71
19	0.43	0.17	2.09	0.52	0.2919	0.0931	1.2642	0.3302	0.60	0.19	0.61	0.43	0.47	0.46	0.40	0.61	0.52
44	0.43	0.32	1.69	0.87	0.2915	0.2411	1.6626	0.6757	0.60	0.50	0.80	0.87	0.64	0.70	0.55	0.70	0.84
36	0.43	0.30	1.66	0.76	0.2875	0.2280	1.6885	0.5706	0.59	0.48	0.81	0.74	0.63	0.66	0.54	0.70	0.78
97	0.43	0.21	1.73	0.85	0.2856	0.1343	1.6267	0.6558	0.59	0.28	0.78	0.85	0.55	0.63	0.44	0.69	0.82
21	0.42	0.31	1.74	0.68	0.2825	0.2335	1.6085	0.4919	0.58	0.49	0.78	0.64	0.62	0.62	0.54	0.68	0.71
47	0.41	0.33	1.73	0.76	0.2720	0.2514	1.6265	0.5684	0.56	0.53	0.78	0.74	0.62	0.65	0.54	0.67	0.76
75	0.41	0.19	2.14	0.61	0.2708	0.1157	1.2165	0.4168	0.56	0.24	0.59	0.54	0.46	0.48	0.40	0.57	0.56
70	0.40	0.19	2.19	0.53	0.2610	0.1142	1.1598	0.3350	0.54	0.24	0.56	0.43	0.45	0.44	0.39	0.55	0.50
85	0.40	0.24	1.98	0.60	0.2602	0.1652	1.3713	0.4124	0.54	0.35	0.66	0.53	0.51	0.52	0.44	0.60	0.60
89	0.40	0.20	2.21	0.70	0.2570	0.1189	1.1477	0.5062	0.53	0.25	0.55	0.66	0.44	0.50	0.39	0.54	0.60
81	0.40	0.23	2.01	0.19	0.2565	0.1502	1.3437	-	0.53	0.31	0.65	-	0.50	0.37	0.42	0.59	0.32
12	0.39	0.22	1.95	0.72	0.2486	0.1399	1.4052	0.5256	0.51	0.29	0.68	0.68	0.49	0.54	0.40	0.60	0.68
28	0.39	0.26	1.82	0.75	0.2481	0.1803	1.5285	0.5569	0.51	0.38	0.74	0.72	0.54	0.59	0.44	0.62	0.73
73	0.39	0.15	2.51	0.61	0.2476	0.0714	0.8411	0.4161	0.51	0.15	0.41	0.54	0.36	0.40	0.33	0.46	0.47
31	0.38	0.19	2.11	0.59	0.2428	0.1182	1.2433	0.3996	0.50	0.25	0.60	0.52	0.45	0.47	0.37	0.55	0.56
60	0.38	0.31	1.62	0.77	0.2411	0.2370	1.7332	0.5736	0.50	0.50	0.84	0.74	0.61	0.64	0.50	0.67	0.79
64	0.37	0.16	2.37	0.42	0.2303	0.0803	0.9830	0.2247	0.48	0.17	0.47	0.29	0.37	0.35	0.32	0.48	0.38
65	0.37	0.27	1.82	0.77	0.2286	0.1937	1.5345	0.5810	0.47	0.40	0.74	0.75	0.54	0.59	0.44	0.61	0.75
16	0.36	0.18	2.11	0.65	0.2254	0.1062	1.2462	0.4559	0.47	0.22	0.60	0.59	0.43	0.47	0.34	0.53	0.60
62	0.36	0.13	2.55	0.38	0.2223	0.0499	0.8038	0.1862	0.46	0.10	0.39	0.24	0.32	0.30	0.28	0.42	0.31
41	0.36	0.32	1.72	0.75	0.2184	0.2443	1.6348	0.5531	0.45	0.51	0.79	0.72	0.58	0.62	0.48	0.62	0.75
68	0.36	0.25	1.97	0.70	0.2171	0.1700	1.3865	0.5102	0.45	0.36	0.67	0.66	0.49	0.53	0.40	0.56	0.66
29	0.36	0.21	1.98	0.62	0.2160	0.1355	1.3685	0.4322	0.45	0.28	0.66	0.56	0.46	0.49	0.37	0.55	0.61
94	0.35	0.38	1.57	0.66	0.2138	0.3049	1.7857	0.4652	0.44	0.64	0.86	0.60	0.65	0.64	0.54	0.65	0.73
9	0.35	0.24	1.83	0.58	0.2129	0.1654	1.5261	0.3917	0.44	0.35	0.74	0.51	0.51	0.51	0.39	0.59	0.62
86	0.35	0.25	1.98	0.61	0.2128	0.1720	1.3776	0.4167	0.44	0.36	0.66	0.54	0.49	0.50	0.40	0.55	0.60
42	0.35	0.20	2.09	0.36	0.2123	0.1200	1.2607	0.1688	0.44	0.25	0.61	0.22	0.43	0.38	0.35	0.52	0.41
39	0.35	0.19	2.16	0.50	0.2095	0.1129	1.1904	0.3097	0.43	0.24	0.57	0.40	0.41	0.41	0.33	0.50	0.49
27	0.35	0.25	1.92	0.70	0.2062	0.1769	1.4291	0.5120	0.43	0.37	0.69	0.66	0.49	0.54	0.40	0.56	0.68
56	0.34	0.22	1.99	0.51	0.1982	0.1460	1.3609	0.3136	0.41	0.31	0.66	0.41	0.46	0.44	0.36	0.53	0.53
92	0.34	0.26	1.89	0.71	0.1969	0.1813	1.4621	0.5214	0.41	0.38	0.70	0.68	0.50	0.54	0.39	0.56	0.69
71	0.33	0.24	1.99	0.77	0.1933	0.1627	1.3660	0.5798	0.40	0.34	0.66	0.75	0.47	0.54	0.37	0.53	0.70
33	0.33	0.23	1.89	0.71	0.1880	0.1572	1.4599	0.5156	0.39	0.33	0.70	0.67	0.47	0.52	0.36	0.55	0.69
58	0.32	0.19	2.11	0.40	0.1842	0.1137	1.2447	0.2088	0.38	0.24	0.60	0.27	0.41	0.37	0.31	0.49	0.44
67	0.32	0.25	1.84	0.77	0.1809	0.1757	1.5148	0.5734	0.37	0.37	0.73	0.74	0.49	0.55	0.37	0.55	0.74
61	0.32	0.17	2.21	0.63	0.1787	0.0948	1.1456	0.4419	0.37	0.20	0.55	0.57	0.37	0.42	0.28	0.46	0.56

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
66	0.31	0.27	1.79	0.74	0.1715	0.1913	1.5618	0.5496	0.35	0.40	0.75	0.71	0.50	0.55	0.38	0.55	0.73
2	0.30	0.18	2.17	0.39	0.1626	0.1016	1.1879	0.1966	0.34	0.21	0.57	0.25	0.37	0.34	0.27	0.45	0.41
59	0.30	0.21	1.98	0.39	0.1621	0.1351	1.3756	0.1985	0.34	0.28	0.66	0.26	0.43	0.38	0.31	0.50	0.46
45	0.29	0.26	1.81	0.73	0.1544	0.1806	1.5425	0.5406	0.32	0.38	0.74	0.70	0.48	0.54	0.35	0.53	0.72
3	0.28	0.21	1.84	0.93	0.1440	0.1373	1.5150	0.7363	0.30	0.29	0.73	0.95	0.44	0.57	0.29	0.51	0.84
98	0.28	0.26	1.78	0.78	0.1402	0.1858	1.5760	0.5837	0.29	0.39	0.76	0.76	0.48	0.55	0.34	0.52	0.76
100	0.28	0.37	1.56	0.64	0.1402	0.2916	1.7884	0.4443	0.29	0.61	0.86	0.58	0.59	0.58	0.45	0.58	0.72
88	0.28	0.13	2.56	0.44	0.1372	0.0509	0.7958	0.2511	0.28	0.11	0.38	0.33	0.26	0.27	0.20	0.33	0.35
20	0.27	0.15	2.28	0.65	0.1313	0.0784	1.0725	0.4545	0.27	0.16	0.52	0.59	0.32	0.39	0.22	0.39	0.55
99	0.27	0.21	1.97	0.82	0.1286	0.1355	1.3822	0.6320	0.27	0.28	0.67	0.82	0.41	0.51	0.27	0.47	0.74
6	0.27	0.26	1.82	0.75	0.1259	0.1825	1.5311	0.5561	0.26	0.38	0.74	0.72	0.46	0.52	0.32	0.50	0.73
1	0.26	0.30	1.69	0.91	0.1244	0.2257	1.6658	0.7185	0.26	0.47	0.80	0.93	0.51	0.62	0.36	0.53	0.87
25	0.26	0.18	2.14	0.51	0.1217	0.1048	1.2094	0.3132	0.25	0.22	0.58	0.41	0.35	0.36	0.24	0.42	0.49
72	0.26	0.08	3.35	0.45	0.1197	-	-	0.2553	0.25	-	-	0.33	0.08	0.14	0.12	0.12	0.17
80	0.26	0.11	2.92	0.53	0.1184	0.0308	0.4366	0.3399	0.24	0.06	0.21	0.44	0.17	0.24	0.15	0.23	0.33
40	0.26	0.17	2.20	0.35	0.1175	0.0935	1.1548	0.1613	0.24	0.20	0.56	0.21	0.33	0.30	0.22	0.40	0.38
23	0.26	0.15	2.25	0.58	0.1171	0.0756	1.0994	0.3904	0.24	0.16	0.53	0.51	0.31	0.36	0.20	0.39	0.52
63	0.25	0.16	2.31	0.63	0.1101	0.0828	1.0481	0.4416	0.23	0.17	0.51	0.57	0.30	0.37	0.20	0.37	0.54
17	0.25	0.09	2.95	0.41	0.1087	0.0171	0.4067	0.2152	0.22	0.04	0.20	0.28	0.15	0.18	0.13	0.21	0.24
34	0.24	0.22	1.91	0.62	0.1036	0.1414	1.4430	0.4231	0.21	0.30	0.70	0.55	0.40	0.44	0.25	0.45	0.62
49	0.24	0.16	2.35	0.70	0.1026	0.0878	1.0004	0.5056	0.21	0.18	0.48	0.65	0.29	0.38	0.20	0.35	0.57
14	0.24	0.16	2.34	0.76	0.0972	0.0829	1.0180	0.5682	0.20	0.17	0.49	0.74	0.29	0.40	0.19	0.35	0.61
51	0.24	0.18	2.15	0.53	0.0969	0.1049	1.2046	0.3329	0.20	0.22	0.58	0.43	0.33	0.36	0.21	0.39	0.51
10	0.23	0.18	2.16	0.47	0.0935	0.1077	1.1890	0.2788	0.19	0.23	0.57	0.36	0.33	0.34	0.21	0.38	0.47
52	0.23	0.25	1.92	0.61	0.0930	0.1772	1.4290	0.4181	0.19	0.37	0.69	0.54	0.42	0.45	0.28	0.44	0.61
93	0.22	0.16	2.42	0.54	0.0808	0.0790	0.9307	0.3449	0.17	0.17	0.45	0.45	0.26	0.31	0.17	0.31	0.45
43	0.22	0.21	2.10	0.72	0.0807	0.1330	1.2501	0.5323	0.17	0.28	0.60	0.69	0.35	0.43	0.22	0.38	0.65
87	0.22	0.17	2.30	0.62	0.0782	0.0905	1.0546	0.4232	0.16	0.19	0.51	0.55	0.29	0.35	0.18	0.33	0.53
96	0.20	0.17	2.19	0.51	0.0647	0.0986	1.1642	0.3169	0.13	0.21	0.56	0.41	0.30	0.33	0.17	0.35	0.49
22	0.20	0.11	2.59	0.50	0.0623	0.0299	0.7662	0.3030	0.13	0.06	0.37	0.39	0.19	0.24	0.10	0.25	0.38
35	0.20	0.19	2.11	0.70	0.0609	0.1183	1.2446	0.5110	0.13	0.25	0.60	0.66	0.32	0.41	0.19	0.36	0.63
5	0.19	0.17	2.29	0.65	0.0547	0.0913	1.0595	0.4560	0.11	0.19	0.51	0.59	0.27	0.35	0.15	0.31	0.55
77	0.19	0.15	2.49	0.52	0.0480	0.0784	0.8599	0.3252	0.10	0.16	0.41	0.42	0.23	0.27	0.13	0.26	0.42
37	0.18	0.18	2.24	0.62	0.0391	0.1033	1.1159	0.4245	0.08	0.22	0.54	0.55	0.28	0.35	0.15	0.31	0.54
48	0.18	0.16	2.24	0.44	0.0372	0.0798	1.1100	0.2432	0.08	0.17	0.53	0.31	0.26	0.27	0.12	0.31	0.42
74	0.16	0.12	2.26	0.40	0.0238	0.0477	1.0932	0.2118	0.05	0.10	0.53	0.27	0.23	0.24	0.07	0.29	0.40
13	0.16	0.13	2.53	0.48	0.0167	0.0569	0.8214	0.2922	0.03	0.12	0.40	0.38	0.18	0.23	0.08	0.22	0.39

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
95	0.14	0.14	2.61	0.43	-	0.0652	0.7384	0.2358	-	0.14	0.36	0.31	0.16	0.20	0.07	0.18	0.33

Districts Challenged for Lack of Compactness

District with a Majority of Adult African-American Population

Sorce: United States Census Bureau, 2011 TIGER File and 2010 Redistricting Data File

TABLE 8-C

Virginia 2011 Enacted House of Delegates Redistricting Plan (HB-5005)

Data on Four Measures of Compactness

Sorted by Polsby-Popper Percentile - High to Low

	Reock	Polsby-Popper	Schwartz-berg	Popula- tion Polygon
Min	0.14	0.08	1.28	0.19
Max	0.62	0.55	3.35	0.96
Mean	0.36	0.24	2.00	0.64
Std. Dev.	0.11	0.09	0.35	0.16

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartz berg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
46	0.52	0.55	1.28	0.94	0.3771	0.4785	2.0752	0.7507	0.78	1.00	1.00	0.97	0.93	0.94	0.89	0.89	0.99
91	0.60	0.47	1.45	0.58	0.4582	0.3930	1.9052	0.3848	0.95	0.82	0.92	0.50	0.90	0.80	0.88	0.93	0.71
38	0.62	0.45	1.44	0.84	0.4834	0.3778	1.9093	0.6430	1.00	0.79	0.92	0.83	0.90	0.89	0.89	0.96	0.88
82	0.57	0.45	1.48	0.72	0.4312	0.3704	1.8781	0.5238	0.89	0.77	0.91	0.68	0.86	0.81	0.83	0.90	0.79
57	0.45	0.41	1.47	0.96	0.3143	0.3304	1.8815	0.7724	0.65	0.69	0.91	1.00	0.75	0.81	0.67	0.78	0.95
94	0.35	0.38	1.57	0.66	0.2138	0.3049	1.7857	0.4652	0.44	0.64	0.86	0.60	0.65	0.64	0.54	0.65	0.73
100	0.28	0.37	1.56	0.64	0.1402	0.2916	1.7884	0.4443	0.29	0.61	0.86	0.58	0.59	0.58	0.45	0.58	0.72
30	0.53	0.36	1.49	0.83	0.3937	0.2882	1.8639	0.6345	0.81	0.60	0.90	0.82	0.77	0.78	0.71	0.86	0.86
26	0.46	0.36	1.57	0.85	0.3182	0.2872	1.7839	0.6575	0.66	0.60	0.86	0.85	0.71	0.74	0.63	0.76	0.86
78	0.46	0.35	1.65	0.77	0.3198	0.2778	1.7061	0.5762	0.66	0.58	0.82	0.75	0.69	0.70	0.62	0.74	0.78
83	0.52	0.34	1.69	0.84	0.3769	0.2663	1.6624	0.6479	0.78	0.56	0.80	0.84	0.71	0.74	0.67	0.79	0.82
69	0.52	0.34	1.68	0.85	0.3799	0.2646	1.6749	0.6579	0.79	0.55	0.81	0.85	0.72	0.75	0.67	0.80	0.83
50	0.46	0.34	1.62	0.77	0.3178	0.2643	1.7371	0.5808	0.66	0.55	0.84	0.75	0.68	0.70	0.60	0.75	0.79
53	0.46	0.34	1.69	0.77	0.3174	0.2588	1.6609	0.5742	0.66	0.54	0.80	0.74	0.67	0.69	0.60	0.73	0.77
15	0.55	0.34	1.52	0.83	0.4072	0.2587	1.8350	0.6339	0.84	0.54	0.88	0.82	0.76	0.77	0.69	0.86	0.85
47	0.41	0.33	1.73	0.76	0.2720	0.2514	1.6265	0.5684	0.56	0.53	0.78	0.74	0.62	0.65	0.54	0.67	0.76
41	0.36	0.32	1.72	0.75	0.2184	0.2443	1.6348	0.5531	0.45	0.51	0.79	0.72	0.58	0.62	0.48	0.62	0.75
44	0.43	0.32	1.69	0.87	0.2915	0.2411	1.6626	0.6757	0.60	0.50	0.80	0.87	0.64	0.70	0.55	0.70	0.84
60	0.38	0.31	1.62	0.77	0.2411	0.2370	1.7332	0.5736	0.50	0.50	0.84	0.74	0.61	0.64	0.50	0.67	0.79
21	0.42	0.31	1.74	0.68	0.2825	0.2335	1.6085	0.4919	0.58	0.49	0.78	0.64	0.62	0.62	0.54	0.68	0.71
32	0.46	0.31	1.64	0.89	0.3196	0.2320	1.7100	0.6950	0.66	0.48	0.82	0.90	0.66	0.72	0.57	0.74	0.86
36	0.43	0.30	1.66	0.76	0.2875	0.2280	1.6885	0.5706	0.59	0.48	0.81	0.74	0.63	0.66	0.54	0.70	0.78
1	0.26	0.30	1.69	0.91	0.1244	0.2257	1.6658	0.7185	0.26	0.47	0.80	0.93	0.51	0.62	0.36	0.53	0.87
55	0.57	0.28	1.69	0.66	0.4291	0.2078	1.6616	0.4718	0.89	0.43	0.80	0.61	0.71	0.68	0.66	0.84	0.71
65	0.37	0.27	1.82	0.77	0.2286	0.1937	1.5345	0.5810	0.47	0.40	0.74	0.75	0.54	0.59	0.44	0.61	0.75

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
66	0.31	0.27	1.79	0.74	0.1715	0.1913	1.5618	0.5496	0.35	0.40	0.75	0.71	0.50	0.55	0.38	0.55	0.73
98	0.28	0.26	1.78	0.78	0.1402	0.1858	1.5760	0.5837	0.29	0.39	0.76	0.76	0.48	0.55	0.34	0.52	0.76
11	0.59	0.26	1.80	0.83	0.4483	0.1857	1.5555	0.6381	0.93	0.39	0.75	0.83	0.69	0.72	0.66	0.84	0.79
8	0.47	0.26	1.83	0.42	0.3263	0.1832	1.5196	0.2269	0.68	0.38	0.73	0.29	0.60	0.52	0.53	0.70	0.51
6	0.27	0.26	1.82	0.75	0.1259	0.1825	1.5311	0.5561	0.26	0.38	0.74	0.72	0.46	0.52	0.32	0.50	0.73
79	0.45	0.26	1.84	0.63	0.3121	0.1816	1.5142	0.4398	0.65	0.38	0.73	0.57	0.58	0.58	0.51	0.69	0.65
92	0.34	0.26	1.89	0.71	0.1969	0.1813	1.4621	0.5214	0.41	0.38	0.70	0.68	0.50	0.54	0.39	0.56	0.69
84	0.44	0.26	1.89	0.75	0.2999	0.1808	1.4640	0.5564	0.62	0.38	0.71	0.72	0.57	0.61	0.50	0.66	0.71
45	0.29	0.26	1.81	0.73	0.1544	0.1806	1.5425	0.5406	0.32	0.38	0.74	0.70	0.48	0.54	0.35	0.53	0.72
28	0.39	0.26	1.82	0.75	0.2481	0.1803	1.5285	0.5569	0.51	0.38	0.74	0.72	0.54	0.59	0.44	0.62	0.73
54	0.47	0.25	1.89	0.71	0.3266	0.1773	1.4625	0.5214	0.68	0.37	0.70	0.68	0.58	0.61	0.52	0.69	0.69
52	0.23	0.25	1.92	0.61	0.0930	0.1772	1.4290	0.4181	0.19	0.37	0.69	0.54	0.42	0.45	0.28	0.44	0.61
27	0.35	0.25	1.92	0.70	0.2062	0.1769	1.4291	0.5120	0.43	0.37	0.69	0.66	0.49	0.54	0.40	0.56	0.68
7	0.50	0.25	1.81	0.61	0.3578	0.1760	1.5439	0.4227	0.74	0.37	0.74	0.55	0.62	0.60	0.55	0.74	0.65
67	0.32	0.25	1.84	0.77	0.1809	0.1757	1.5148	0.5734	0.37	0.37	0.73	0.74	0.49	0.55	0.37	0.55	0.74
86	0.35	0.25	1.98	0.61	0.2128	0.1720	1.3776	0.4167	0.44	0.36	0.66	0.54	0.49	0.50	0.40	0.55	0.60
24	0.44	0.25	1.78	0.78	0.3038	0.1711	1.5727	0.5845	0.63	0.36	0.76	0.76	0.58	0.63	0.49	0.69	0.76
68	0.36	0.25	1.97	0.70	0.2171	0.1700	1.3865	0.5102	0.45	0.36	0.67	0.66	0.49	0.53	0.40	0.56	0.66
9	0.35	0.24	1.83	0.58	0.2129	0.1654	1.5261	0.3917	0.44	0.35	0.74	0.51	0.51	0.51	0.39	0.59	0.62
85	0.40	0.24	1.98	0.60	0.2602	0.1652	1.3713	0.4124	0.54	0.35	0.66	0.53	0.51	0.52	0.44	0.60	0.60
71	0.33	0.24	1.99	0.77	0.1933	0.1627	1.3660	0.5798	0.40	0.34	0.66	0.75	0.47	0.54	0.37	0.53	0.70
18	0.62	0.24	1.92	0.62	0.4787	0.1594	1.4285	0.4322	0.99	0.33	0.69	0.56	0.67	0.64	0.66	0.84	0.62
33	0.33	0.23	1.89	0.71	0.1880	0.1572	1.4599	0.5156	0.39	0.33	0.70	0.67	0.47	0.52	0.36	0.55	0.69
81	0.40	0.23	2.01	0.19	0.2565	0.1502	1.3437	-	0.53	0.31	0.65	-	0.50	0.37	0.42	0.59	0.32
56	0.34	0.22	1.99	0.51	0.1982	0.1460	1.3609	0.3136	0.41	0.31	0.66	0.41	0.46	0.44	0.36	0.53	0.53
34	0.24	0.22	1.91	0.62	0.1036	0.1414	1.4430	0.4231	0.21	0.30	0.70	0.55	0.40	0.44	0.25	0.45	0.62
12	0.39	0.22	1.95	0.72	0.2486	0.1399	1.4052	0.5256	0.51	0.29	0.68	0.68	0.49	0.54	0.40	0.60	0.68
3	0.28	0.21	1.84	0.93	0.1440	0.1373	1.5150	0.7363	0.30	0.29	0.73	0.95	0.44	0.57	0.29	0.51	0.84
99	0.27	0.21	1.97	0.82	0.1286	0.1355	1.3822	0.6320	0.27	0.28	0.67	0.82	0.41	0.51	0.27	0.47	0.74
29	0.36	0.21	1.98	0.62	0.2160	0.1355	1.3685	0.4322	0.45	0.28	0.66	0.56	0.46	0.49	0.37	0.55	0.61
59	0.30	0.21	1.98	0.39	0.1621	0.1351	1.3756	0.1985	0.34	0.28	0.66	0.26	0.43	0.38	0.31	0.50	0.46
97	0.43	0.21	1.73	0.85	0.2856	0.1343	1.6267	0.6558	0.59	0.28	0.78	0.85	0.55	0.63	0.44	0.69	0.82
43	0.22	0.21	2.10	0.72	0.0807	0.1330	1.2501	0.5323	0.17	0.28	0.60	0.69	0.35	0.43	0.22	0.38	0.65
90	0.46	0.20	2.17	0.65	0.3156	0.1263	1.1877	0.4580	0.65	0.26	0.57	0.59	0.50	0.52	0.46	0.61	0.58
4	0.49	0.20	1.97	0.66	0.3455	0.1217	1.3868	0.4693	0.71	0.25	0.67	0.61	0.55	0.56	0.48	0.69	0.64
42	0.35	0.20	2.09	0.36	0.2123	0.1200	1.2607	0.1688	0.44	0.25	0.61	0.22	0.43	0.38	0.35	0.52	0.41
89	0.40	0.20	2.21	0.70	0.2570	0.1189	1.1477	0.5062	0.53	0.25	0.55	0.66	0.44	0.50	0.39	0.54	0.60

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
35	0.20	0.19	2.11	0.70	0.0609	0.1183	1.2446	0.5110	0.13	0.25	0.60	0.66	0.32	0.41	0.19	0.36	0.63
31	0.38	0.19	2.11	0.59	0.2428	0.1182	1.2433	0.3996	0.50	0.25	0.60	0.52	0.45	0.47	0.37	0.55	0.56
75	0.41	0.19	2.14	0.61	0.2708	0.1157	1.2165	0.4168	0.56	0.24	0.59	0.54	0.46	0.48	0.40	0.57	0.56
70	0.40	0.19	2.19	0.53	0.2610	0.1142	1.1598	0.3350	0.54	0.24	0.56	0.43	0.45	0.44	0.39	0.55	0.50
58	0.32	0.19	2.11	0.40	0.1842	0.1137	1.2447	0.2088	0.38	0.24	0.60	0.27	0.41	0.37	0.31	0.49	0.44
39	0.35	0.19	2.16	0.50	0.2095	0.1129	1.1904	0.3097	0.43	0.24	0.57	0.40	0.41	0.41	0.33	0.50	0.49
10	0.23	0.18	2.16	0.47	0.0935	0.1077	1.1890	0.2788	0.19	0.23	0.57	0.36	0.33	0.34	0.21	0.38	0.47
16	0.36	0.18	2.11	0.65	0.2254	0.1062	1.2462	0.4559	0.47	0.22	0.60	0.59	0.43	0.47	0.34	0.53	0.60
51	0.24	0.18	2.15	0.53	0.0969	0.1049	1.2046	0.3329	0.20	0.22	0.58	0.43	0.33	0.36	0.21	0.39	0.51
25	0.26	0.18	2.14	0.51	0.1217	0.1048	1.2094	0.3132	0.25	0.22	0.58	0.41	0.35	0.36	0.24	0.42	0.49
37	0.18	0.18	2.24	0.62	0.0391	0.1033	1.1159	0.4245	0.08	0.22	0.54	0.55	0.28	0.35	0.15	0.31	0.54
2	0.30	0.18	2.17	0.39	0.1626	0.1016	1.1879	0.1966	0.34	0.21	0.57	0.25	0.37	0.34	0.27	0.45	0.41
96	0.20	0.17	2.19	0.51	0.0647	0.0986	1.1642	0.3169	0.13	0.21	0.56	0.41	0.30	0.33	0.17	0.35	0.49
61	0.32	0.17	2.21	0.63	0.1787	0.0948	1.1456	0.4419	0.37	0.20	0.55	0.57	0.37	0.42	0.28	0.46	0.56
40	0.26	0.17	2.20	0.35	0.1175	0.0935	1.1548	0.1613	0.24	0.20	0.56	0.21	0.33	0.30	0.22	0.40	0.38
19	0.43	0.17	2.09	0.52	0.2919	0.0931	1.2642	0.3302	0.60	0.19	0.61	0.43	0.47	0.46	0.40	0.61	0.52
76	0.48	0.17	2.37	0.43	0.3429	0.0919	0.9790	0.2347	0.71	0.19	0.47	0.30	0.46	0.42	0.45	0.59	0.39
5	0.19	0.17	2.29	0.65	0.0547	0.0913	1.0595	0.4560	0.11	0.19	0.51	0.59	0.27	0.35	0.15	0.31	0.55
87	0.22	0.17	2.30	0.62	0.0782	0.0905	1.0546	0.4232	0.16	0.19	0.51	0.55	0.29	0.35	0.18	0.33	0.53
49	0.24	0.16	2.35	0.70	0.1026	0.0878	1.0004	0.5056	0.21	0.18	0.48	0.65	0.29	0.38	0.20	0.35	0.57
14	0.24	0.16	2.34	0.76	0.0972	0.0829	1.0180	0.5682	0.20	0.17	0.49	0.74	0.29	0.40	0.19	0.35	0.61
63	0.25	0.16	2.31	0.63	0.1101	0.0828	1.0481	0.4416	0.23	0.17	0.51	0.57	0.30	0.37	0.20	0.37	0.54
64	0.37	0.16	2.37	0.42	0.2303	0.0803	0.9830	0.2247	0.48	0.17	0.47	0.29	0.37	0.35	0.32	0.48	0.38
48	0.18	0.16	2.24	0.44	0.0372	0.0798	1.1100	0.2432	0.08	0.17	0.53	0.31	0.26	0.27	0.12	0.31	0.42
93	0.22	0.16	2.42	0.54	0.0808	0.0790	0.9307	0.3449	0.17	0.17	0.45	0.45	0.26	0.31	0.17	0.31	0.45
20	0.27	0.15	2.28	0.65	0.1313	0.0784	1.0725	0.4545	0.27	0.16	0.52	0.59	0.32	0.39	0.22	0.39	0.55
77	0.19	0.15	2.49	0.52	0.0480	0.0784	0.8599	0.3252	0.10	0.16	0.41	0.42	0.23	0.27	0.13	0.26	0.42
23	0.26	0.15	2.25	0.58	0.1171	0.0756	1.0994	0.3904	0.24	0.16	0.53	0.51	0.31	0.36	0.20	0.39	0.52
73	0.39	0.15	2.51	0.61	0.2476	0.0714	0.8411	0.4161	0.51	0.15	0.41	0.54	0.36	0.40	0.33	0.46	0.47
95	0.14	0.14	2.61	0.43	-	0.0652	0.7384	0.2358	-	0.14	0.36	0.31	0.16	0.20	0.07	0.18	0.33
13	0.16	0.13	2.53	0.48	0.0167	0.0569	0.8214	0.2922	0.03	0.12	0.40	0.38	0.18	0.23	0.08	0.22	0.39
88	0.28	0.13	2.56	0.44	0.1372	0.0509	0.7958	0.2511	0.28	0.11	0.38	0.33	0.26	0.27	0.20	0.33	0.35
62	0.36	0.13	2.55	0.38	0.2223	0.0499	0.8038	0.1862	0.46	0.10	0.39	0.24	0.32	0.30	0.28	0.42	0.31
74	0.16	0.12	2.26	0.40	0.0238	0.0477	1.0932	0.2118	0.05	0.10	0.53	0.27	0.23	0.24	0.07	0.29	0.40
80	0.26	0.11	2.92	0.53	0.1184	0.0308	0.4366	0.3399	0.24	0.06	0.21	0.44	0.17	0.24	0.15	0.23	0.33
22	0.20	0.11	2.59	0.50	0.0623	0.0299	0.7662	0.3030	0.13	0.06	0.37	0.39	0.19	0.24	0.10	0.25	0.38
17	0.25	0.09	2.95	0.41	0.1087	0.0171	0.4067	0.2152	0.22	0.04	0.20	0.28	0.15	0.18	0.13	0.21	0.24

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
72	0.26	0.08	3.35	0.45	0.1197	-	-	0.2553	0.25	-	-	0.33	0.08	0.14	0.12	0.12	0.17

Districts Challenged for Lack of Compactness

District with a Majority of Adult African-American Population

Sorce: United States Census Bureau, 2011 TIGER File and 2010 Redistricting Data File

TABLE 8-D

Virginia 2011 Enacted House of Delegates Redistricting Plan (HB-5005)

Data on Four Measures of Compactness

Sorted by Schwartzberg Percentile - High to Low

	Reock	Polsby-Popper	Schwartz-berg	Popula- tion Polygon
Min	0.14	0.08	1.28	0.19
Max	0.62	0.55	3.35	0.96
Mean	0.36	0.24	2.00	0.64
Std. Dev.	0.11	0.09	0.35	0.16

District	Compactness Score				Distance Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartz berg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
46	0.52	0.55	1.28	0.94	0.3771	0.4785	2.0752	0.7507	0.78	1.00	1.00	0.97	0.93	0.94	0.89	0.89	0.99
38	0.62	0.45	1.44	0.84	0.4834	0.3778	1.9093	0.6430	1.00	0.79	0.92	0.83	0.90	0.89	0.89	0.96	0.88
91	0.60	0.47	1.45	0.58	0.4582	0.3930	1.9052	0.3848	0.95	0.82	0.92	0.50	0.90	0.80	0.88	0.93	0.71
57	0.45	0.41	1.47	0.96	0.3143	0.3304	1.8815	0.7724	0.65	0.69	0.91	1.00	0.75	0.81	0.67	0.78	0.95
82	0.57	0.45	1.48	0.72	0.4312	0.3704	1.8781	0.5238	0.89	0.77	0.91	0.68	0.86	0.81	0.83	0.90	0.79
30	0.53	0.36	1.49	0.83	0.3937	0.2882	1.8639	0.6345	0.81	0.60	0.90	0.82	0.77	0.78	0.71	0.86	0.86
15	0.55	0.34	1.52	0.83	0.4072	0.2587	1.8350	0.6339	0.84	0.54	0.88	0.82	0.76	0.77	0.69	0.86	0.85
100	0.28	0.37	1.56	0.64	0.1402	0.2916	1.7884	0.4443	0.29	0.61	0.86	0.58	0.59	0.58	0.45	0.58	0.72
94	0.35	0.38	1.57	0.66	0.2138	0.3049	1.7857	0.4652	0.44	0.64	0.86	0.60	0.65	0.64	0.54	0.65	0.73
26	0.46	0.36	1.57	0.85	0.3182	0.2872	1.7839	0.6575	0.66	0.60	0.86	0.85	0.71	0.74	0.63	0.76	0.86
50	0.46	0.34	1.62	0.77	0.3178	0.2643	1.7371	0.5808	0.66	0.55	0.84	0.75	0.68	0.70	0.60	0.75	0.79
60	0.38	0.31	1.62	0.77	0.2411	0.2370	1.7332	0.5736	0.50	0.50	0.84	0.74	0.61	0.64	0.50	0.67	0.79
32	0.46	0.31	1.64	0.89	0.3196	0.2320	1.7100	0.6950	0.66	0.48	0.82	0.90	0.66	0.72	0.57	0.74	0.86
78	0.46	0.35	1.65	0.77	0.3198	0.2778	1.7061	0.5762	0.66	0.58	0.82	0.75	0.69	0.70	0.62	0.74	0.78
36	0.43	0.30	1.66	0.76	0.2875	0.2280	1.6885	0.5706	0.59	0.48	0.81	0.74	0.63	0.66	0.54	0.70	0.78
69	0.52	0.34	1.68	0.85	0.3799	0.2646	1.6749	0.6579	0.79	0.55	0.81	0.85	0.72	0.75	0.67	0.80	0.83
1	0.26	0.30	1.69	0.91	0.1244	0.2257	1.6658	0.7185	0.26	0.47	0.80	0.93	0.51	0.62	0.36	0.53	0.87
44	0.43	0.32	1.69	0.87	0.2915	0.2411	1.6626	0.6757	0.60	0.50	0.80	0.87	0.64	0.70	0.55	0.70	0.84
83	0.52	0.34	1.69	0.84	0.3769	0.2663	1.6624	0.6479	0.78	0.56	0.80	0.84	0.71	0.74	0.67	0.79	0.82
55	0.57	0.28	1.69	0.66	0.4291	0.2078	1.6616	0.4718	0.89	0.43	0.80	0.61	0.71	0.68	0.66	0.84	0.71
53	0.46	0.34	1.69	0.77	0.3174	0.2588	1.6609	0.5742	0.66	0.54	0.80	0.74	0.67	0.69	0.60	0.73	0.77
41	0.36	0.32	1.72	0.75	0.2184	0.2443	1.6348	0.5531	0.45	0.51	0.79	0.72	0.58	0.62	0.48	0.62	0.75
97	0.43	0.21	1.73	0.85	0.2856	0.1343	1.6267	0.6558	0.59	0.28	0.78	0.85	0.55	0.63	0.44	0.69	0.82
47	0.41	0.33	1.73	0.76	0.2720	0.2514	1.6265	0.5684	0.56	0.53	0.78	0.74	0.62	0.65	0.54	0.67	0.76
21	0.42	0.31	1.74	0.68	0.2825	0.2335	1.6085	0.4919	0.58	0.49	0.78	0.64	0.62	0.62	0.54	0.68	0.71

District	Compactness Score				Distance Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
98	0.28	0.26	1.78	0.78	0.1402	0.1858	1.5760	0.5837	0.29	0.39	0.76	0.76	0.48	0.55	0.34	0.52	0.76
24	0.44	0.25	1.78	0.78	0.3038	0.1711	1.5727	0.5845	0.63	0.36	0.76	0.76	0.58	0.63	0.49	0.69	0.76
66	0.31	0.27	1.79	0.74	0.1715	0.1913	1.5618	0.5496	0.35	0.40	0.75	0.71	0.50	0.55	0.38	0.55	0.73
11	0.59	0.26	1.80	0.83	0.4483	0.1857	1.5555	0.6381	0.93	0.39	0.75	0.83	0.69	0.72	0.66	0.84	0.79
7	0.50	0.25	1.81	0.61	0.3578	0.1760	1.5439	0.4227	0.74	0.37	0.74	0.55	0.62	0.60	0.55	0.74	0.65
45	0.29	0.26	1.81	0.73	0.1544	0.1806	1.5425	0.5406	0.32	0.38	0.74	0.70	0.48	0.54	0.35	0.53	0.72
65	0.37	0.27	1.82	0.77	0.2286	0.1937	1.5345	0.5810	0.47	0.40	0.74	0.75	0.54	0.59	0.44	0.61	0.75
6	0.27	0.26	1.82	0.75	0.1259	0.1825	1.5311	0.5561	0.26	0.38	0.74	0.72	0.46	0.52	0.32	0.50	0.73
28	0.39	0.26	1.82	0.75	0.2481	0.1803	1.5285	0.5569	0.51	0.38	0.74	0.72	0.54	0.59	0.44	0.62	0.73
9	0.35	0.24	1.83	0.58	0.2129	0.1654	1.5261	0.3917	0.44	0.35	0.74	0.51	0.51	0.51	0.39	0.59	0.62
8	0.47	0.26	1.83	0.42	0.3263	0.1832	1.5196	0.2269	0.68	0.38	0.73	0.29	0.60	0.52	0.53	0.70	0.51
3	0.28	0.21	1.84	0.93	0.1440	0.1373	1.5150	0.7363	0.30	0.29	0.73	0.95	0.44	0.57	0.29	0.51	0.84
67	0.32	0.25	1.84	0.77	0.1809	0.1757	1.5148	0.5734	0.37	0.37	0.73	0.74	0.49	0.55	0.37	0.55	0.74
79	0.45	0.26	1.84	0.63	0.3121	0.1816	1.5142	0.4398	0.65	0.38	0.73	0.57	0.58	0.58	0.51	0.69	0.65
84	0.44	0.26	1.89	0.75	0.2999	0.1808	1.4640	0.5564	0.62	0.38	0.71	0.72	0.57	0.61	0.50	0.66	0.71
54	0.47	0.25	1.89	0.71	0.3266	0.1773	1.4625	0.5214	0.68	0.37	0.70	0.68	0.58	0.61	0.52	0.69	0.69
92	0.34	0.26	1.89	0.71	0.1969	0.1813	1.4621	0.5214	0.41	0.38	0.70	0.68	0.50	0.54	0.39	0.56	0.69
33	0.33	0.23	1.89	0.71	0.1880	0.1572	1.4599	0.5156	0.39	0.33	0.70	0.67	0.47	0.52	0.36	0.55	0.69
34	0.24	0.22	1.91	0.62	0.1036	0.1414	1.4430	0.4231	0.21	0.30	0.70	0.55	0.40	0.44	0.25	0.45	0.62
27	0.35	0.25	1.92	0.70	0.2062	0.1769	1.4291	0.5120	0.43	0.37	0.69	0.66	0.49	0.54	0.40	0.56	0.68
52	0.23	0.25	1.92	0.61	0.0930	0.1772	1.4290	0.4181	0.19	0.37	0.69	0.54	0.42	0.45	0.28	0.44	0.61
18	0.62	0.24	1.92	0.62	0.4787	0.1594	1.4285	0.4322	0.99	0.33	0.69	0.56	0.67	0.64	0.66	0.84	0.62
12	0.39	0.22	1.95	0.72	0.2486	0.1399	1.4052	0.5256	0.51	0.29	0.68	0.68	0.49	0.54	0.40	0.60	0.68
4	0.49	0.20	1.97	0.66	0.3455	0.1217	1.3868	0.4693	0.71	0.25	0.67	0.61	0.55	0.56	0.48	0.69	0.64
68	0.36	0.25	1.97	0.70	0.2171	0.1700	1.3865	0.5102	0.45	0.36	0.67	0.66	0.49	0.53	0.40	0.56	0.66
99	0.27	0.21	1.97	0.82	0.1286	0.1355	1.3822	0.6320	0.27	0.28	0.67	0.82	0.41	0.51	0.27	0.47	0.74
86	0.35	0.25	1.98	0.61	0.2128	0.1720	1.3776	0.4167	0.44	0.36	0.66	0.54	0.49	0.50	0.40	0.55	0.60
59	0.30	0.21	1.98	0.39	0.1621	0.1351	1.3756	0.1985	0.34	0.28	0.66	0.26	0.43	0.38	0.31	0.50	0.46
85	0.40	0.24	1.98	0.60	0.2602	0.1652	1.3713	0.4124	0.54	0.35	0.66	0.53	0.51	0.52	0.44	0.60	0.60
29	0.36	0.21	1.98	0.62	0.2160	0.1355	1.3685	0.4322	0.45	0.28	0.66	0.56	0.46	0.49	0.37	0.55	0.61
71	0.33	0.24	1.99	0.77	0.1933	0.1627	1.3660	0.5798	0.40	0.34	0.66	0.75	0.47	0.54	0.37	0.53	0.70
56	0.34	0.22	1.99	0.51	0.1982	0.1460	1.3609	0.3136	0.41	0.31	0.66	0.41	0.46	0.44	0.36	0.53	0.53
81	0.40	0.23	2.01	0.19	0.2565	0.1502	1.3437	-	0.53	0.31	0.65	-	0.50	0.37	0.42	0.59	0.32
19	0.43	0.17	2.09	0.52	0.2919	0.0931	1.2642	0.3302	0.60	0.19	0.61	0.43	0.47	0.46	0.40	0.61	0.52
42	0.35	0.20	2.09	0.36	0.2123	0.1200	1.2607	0.1688	0.44	0.25	0.61	0.22	0.43	0.38	0.35	0.52	0.41
43	0.22	0.21	2.10	0.72	0.0807	0.1330	1.2501	0.5323	0.17	0.28	0.60	0.69	0.35	0.43	0.22	0.38	0.65
16	0.36	0.18	2.11	0.65	0.2254	0.1062	1.2462	0.4559	0.47	0.22	0.60	0.59	0.43	0.47	0.34	0.53	0.60

District	Compactness Score				Distance Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
58	0.32	0.19	2.11	0.40	0.1842	0.1137	1.2447	0.2088	0.38	0.24	0.60	0.27	0.41	0.37	0.31	0.49	0.44
35	0.20	0.19	2.11	0.70	0.0609	0.1183	1.2446	0.5110	0.13	0.25	0.60	0.66	0.32	0.41	0.19	0.36	0.63
31	0.38	0.19	2.11	0.59	0.2428	0.1182	1.2433	0.3996	0.50	0.25	0.60	0.52	0.45	0.47	0.37	0.55	0.56
75	0.41	0.19	2.14	0.61	0.2708	0.1157	1.2165	0.4168	0.56	0.24	0.59	0.54	0.46	0.48	0.40	0.57	0.56
25	0.26	0.18	2.14	0.51	0.1217	0.1048	1.2094	0.3132	0.25	0.22	0.58	0.41	0.35	0.36	0.24	0.42	0.49
51	0.24	0.18	2.15	0.53	0.0969	0.1049	1.2046	0.3329	0.20	0.22	0.58	0.43	0.33	0.36	0.21	0.39	0.51
39	0.35	0.19	2.16	0.50	0.2095	0.1129	1.1904	0.3097	0.43	0.24	0.57	0.40	0.41	0.41	0.33	0.50	0.49
10	0.23	0.18	2.16	0.47	0.0935	0.1077	1.1890	0.2788	0.19	0.23	0.57	0.36	0.33	0.34	0.21	0.38	0.47
2	0.30	0.18	2.17	0.39	0.1626	0.1016	1.1879	0.1966	0.34	0.21	0.57	0.25	0.37	0.34	0.27	0.45	0.41
90	0.46	0.20	2.17	0.65	0.3156	0.1263	1.1877	0.4580	0.65	0.26	0.57	0.59	0.50	0.52	0.46	0.61	0.58
96	0.20	0.17	2.19	0.51	0.0647	0.0986	1.1642	0.3169	0.13	0.21	0.56	0.41	0.30	0.33	0.17	0.35	0.49
70	0.40	0.19	2.19	0.53	0.2610	0.1142	1.1598	0.3350	0.54	0.24	0.56	0.43	0.45	0.44	0.39	0.55	0.50
40	0.26	0.17	2.20	0.35	0.1175	0.0935	1.1548	0.1613	0.24	0.20	0.56	0.21	0.33	0.30	0.22	0.40	0.38
89	0.40	0.20	2.21	0.70	0.2570	0.1189	1.1477	0.5062	0.53	0.25	0.55	0.66	0.44	0.50	0.39	0.54	0.60
61	0.32	0.17	2.21	0.63	0.1787	0.0948	1.1456	0.4419	0.37	0.20	0.55	0.57	0.37	0.42	0.28	0.46	0.56
37	0.18	0.18	2.24	0.62	0.0391	0.1033	1.1159	0.4245	0.08	0.22	0.54	0.55	0.28	0.35	0.15	0.31	0.54
48	0.18	0.16	2.24	0.44	0.0372	0.0798	1.1100	0.2432	0.08	0.17	0.53	0.31	0.26	0.27	0.12	0.31	0.42
23	0.26	0.15	2.25	0.58	0.1171	0.0756	1.0994	0.3904	0.24	0.16	0.53	0.51	0.31	0.36	0.20	0.39	0.52
74	0.16	0.12	2.26	0.40	0.0238	0.0477	1.0932	0.2118	0.05	0.10	0.53	0.27	0.23	0.24	0.07	0.29	0.40
20	0.27	0.15	2.28	0.65	0.1313	0.0784	1.0725	0.4545	0.27	0.16	0.52	0.59	0.32	0.39	0.22	0.39	0.55
5	0.19	0.17	2.29	0.65	0.0547	0.0913	1.0595	0.4560	0.11	0.19	0.51	0.59	0.27	0.35	0.15	0.31	0.55
87	0.22	0.17	2.30	0.62	0.0782	0.0905	1.0546	0.4232	0.16	0.19	0.51	0.55	0.29	0.35	0.18	0.33	0.53
63	0.25	0.16	2.31	0.63	0.1101	0.0828	1.0481	0.4416	0.23	0.17	0.51	0.57	0.30	0.37	0.20	0.37	0.54
14	0.24	0.16	2.34	0.76	0.0972	0.0829	1.0180	0.5682	0.20	0.17	0.49	0.74	0.29	0.40	0.19	0.35	0.61
49	0.24	0.16	2.35	0.70	0.1026	0.0878	1.0004	0.5056	0.21	0.18	0.48	0.65	0.29	0.38	0.20	0.35	0.57
64	0.37	0.16	2.37	0.42	0.2303	0.0803	0.9830	0.2247	0.48	0.17	0.47	0.29	0.37	0.35	0.32	0.48	0.38
76	0.48	0.17	2.37	0.43	0.3429	0.0919	0.9790	0.2347	0.71	0.19	0.47	0.30	0.46	0.42	0.45	0.59	0.39
93	0.22	0.16	2.42	0.54	0.0808	0.0790	0.9307	0.3449	0.17	0.17	0.45	0.45	0.26	0.31	0.17	0.31	0.45
77	0.19	0.15	2.49	0.52	0.0480	0.0784	0.8599	0.3252	0.10	0.16	0.41	0.42	0.23	0.27	0.13	0.26	0.42
73	0.39	0.15	2.51	0.61	0.2476	0.0714	0.8411	0.4161	0.51	0.15	0.41	0.54	0.36	0.40	0.33	0.46	0.47
13	0.16	0.13	2.53	0.48	0.0167	0.0569	0.8214	0.2922	0.03	0.12	0.40	0.38	0.18	0.23	0.08	0.22	0.39
62	0.36	0.13	2.55	0.38	0.2223	0.0499	0.8038	0.1862	0.46	0.10	0.39	0.24	0.32	0.30	0.28	0.42	0.31
88	0.28	0.13	2.56	0.44	0.1372	0.0509	0.7958	0.2511	0.28	0.11	0.38	0.33	0.26	0.27	0.20	0.33	0.35
22	0.20	0.11	2.59	0.50	0.0623	0.0299	0.7662	0.3030	0.13	0.06	0.37	0.39	0.19	0.24	0.10	0.25	0.38
95	0.14	0.14	2.61	0.43	-	0.0652	0.7384	0.2358	-	0.14	0.36	0.31	0.16	0.20	0.07	0.18	0.33
80	0.26	0.11	2.92	0.53	0.1184	0.0308	0.4366	0.3399	0.24	0.06	0.21	0.44	0.17	0.24	0.15	0.23	0.33
17	0.25	0.09	2.95	0.41	0.1087	0.0171	0.4067	0.2152	0.22	0.04	0.20	0.28	0.15	0.18	0.13	0.21	0.24

District	Compactness Score				Distance Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
72	0.26	0.08	3.35	0.45	0.1197	-	-	0.2553	0.25	-	-	0.33	0.08	0.14	0.12	0.12	0.17

Districts Challenged for Lack of Compactness

District with a Majority of Adult African-American Population

Sorce: United States Census Bureau, 2011 TIGER File and 2010 Redistricting Data File

TABLE 8-E

Virginia 2011 Enacted House of Delegates Redistricting Plan (HB-5005)

Data on Four Measures of Compactness

Sorted by Population-Polygon Percentile - High to Low

	Reock	Polsby-Popper	Schwartz-berg	Popula- tion Polygon
Min	0.14	0.08	1.28	0.19
Max	0.62	0.55	3.35	0.96
Mean	0.36	0.24	2.00	0.64
Std. Dev.	0.11	0.09	0.35	0.16

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartz berg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
57	0.45	0.41	1.47	0.96	0.3143	0.3304	1.8815	0.7724	0.65	0.69	0.91	1.00	0.75	0.81	0.67	0.78	0.95
46	0.52	0.55	1.28	0.94	0.3771	0.4785	2.0752	0.7507	0.78	1.00	1.00	0.97	0.93	0.94	0.89	0.89	0.99
3	0.28	0.21	1.84	0.93	0.1440	0.1373	1.5150	0.7363	0.30	0.29	0.73	0.95	0.44	0.57	0.29	0.51	0.84
1	0.26	0.30	1.69	0.91	0.1244	0.2257	1.6658	0.7185	0.26	0.47	0.80	0.93	0.51	0.62	0.36	0.53	0.87
32	0.46	0.31	1.64	0.89	0.3196	0.2320	1.7100	0.6950	0.66	0.48	0.82	0.90	0.66	0.72	0.57	0.74	0.86
44	0.43	0.32	1.69	0.87	0.2915	0.2411	1.6626	0.6757	0.60	0.50	0.80	0.87	0.64	0.70	0.55	0.70	0.84
69	0.52	0.34	1.68	0.85	0.3799	0.2646	1.6749	0.6579	0.79	0.55	0.81	0.85	0.72	0.75	0.67	0.80	0.83
26	0.46	0.36	1.57	0.85	0.3182	0.2872	1.7839	0.6575	0.66	0.60	0.86	0.85	0.71	0.74	0.63	0.76	0.86
97	0.43	0.21	1.73	0.85	0.2856	0.1343	1.6267	0.6558	0.59	0.28	0.78	0.85	0.55	0.63	0.44	0.69	0.82
83	0.52	0.34	1.69	0.84	0.3769	0.2663	1.6624	0.6479	0.78	0.56	0.80	0.84	0.71	0.74	0.67	0.79	0.82
38	0.62	0.45	1.44	0.84	0.4834	0.3778	1.9093	0.6430	1.00	0.79	0.92	0.83	0.90	0.89	0.89	0.96	0.88
11	0.59	0.26	1.80	0.83	0.4483	0.1857	1.5555	0.6381	0.93	0.39	0.75	0.83	0.69	0.72	0.66	0.84	0.79
30	0.53	0.36	1.49	0.83	0.3937	0.2882	1.8639	0.6345	0.81	0.60	0.90	0.82	0.77	0.78	0.71	0.86	0.86
15	0.55	0.34	1.52	0.83	0.4072	0.2587	1.8350	0.6339	0.84	0.54	0.88	0.82	0.76	0.77	0.69	0.86	0.85
99	0.27	0.21	1.97	0.82	0.1286	0.1355	1.3822	0.6320	0.27	0.28	0.67	0.82	0.41	0.51	0.27	0.47	0.74
24	0.44	0.25	1.78	0.78	0.3038	0.1711	1.5727	0.5845	0.63	0.36	0.76	0.76	0.58	0.63	0.49	0.69	0.76
98	0.28	0.26	1.78	0.78	0.1402	0.1858	1.5760	0.5837	0.29	0.39	0.76	0.76	0.48	0.55	0.34	0.52	0.76
65	0.37	0.27	1.82	0.77	0.2286	0.1937	1.5345	0.5810	0.47	0.40	0.74	0.75	0.54	0.59	0.44	0.61	0.75
50	0.46	0.34	1.62	0.77	0.3178	0.2643	1.7371	0.5808	0.66	0.55	0.84	0.75	0.68	0.70	0.60	0.75	0.79
71	0.33	0.24	1.99	0.77	0.1933	0.1627	1.3660	0.5798	0.40	0.34	0.66	0.75	0.47	0.54	0.37	0.53	0.70
78	0.46	0.35	1.65	0.77	0.3198	0.2778	1.7061	0.5762	0.66	0.58	0.82	0.75	0.69	0.70	0.62	0.74	0.78
53	0.46	0.34	1.69	0.77	0.3174	0.2588	1.6609	0.5742	0.66	0.54	0.80	0.74	0.67	0.69	0.60	0.73	0.77
60	0.38	0.31	1.62	0.77	0.2411	0.2370	1.7332	0.5736	0.50	0.50	0.84	0.74	0.61	0.64	0.50	0.67	0.79
67	0.32	0.25	1.84	0.77	0.1809	0.1757	1.5148	0.5734	0.37	0.37	0.73	0.74	0.49	0.55	0.37	0.55	0.74
36	0.43	0.30	1.66	0.76	0.2875	0.2280	1.6885	0.5706	0.59	0.48	0.81	0.74	0.63	0.66	0.54	0.70	0.78

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
47	0.41	0.33	1.73	0.76	0.2720	0.2514	1.6265	0.5684	0.56	0.53	0.78	0.74	0.62	0.65	0.54	0.67	0.76
14	0.24	0.16	2.34	0.76	0.0972	0.0829	1.0180	0.5682	0.20	0.17	0.49	0.74	0.29	0.40	0.19	0.35	0.61
28	0.39	0.26	1.82	0.75	0.2481	0.1803	1.5285	0.5569	0.51	0.38	0.74	0.72	0.54	0.59	0.44	0.62	0.73
84	0.44	0.26	1.89	0.75	0.2999	0.1808	1.4640	0.5564	0.62	0.38	0.71	0.72	0.57	0.61	0.50	0.66	0.71
6	0.27	0.26	1.82	0.75	0.1259	0.1825	1.5311	0.5561	0.26	0.38	0.74	0.72	0.46	0.52	0.32	0.50	0.73
41	0.36	0.32	1.72	0.75	0.2184	0.2443	1.6348	0.5531	0.45	0.51	0.79	0.72	0.58	0.62	0.48	0.62	0.75
66	0.31	0.27	1.79	0.74	0.1715	0.1913	1.5618	0.5496	0.35	0.40	0.75	0.71	0.50	0.55	0.38	0.55	0.73
45	0.29	0.26	1.81	0.73	0.1544	0.1806	1.5425	0.5406	0.32	0.38	0.74	0.70	0.48	0.54	0.35	0.53	0.72
43	0.22	0.21	2.10	0.72	0.0807	0.1330	1.2501	0.5323	0.17	0.28	0.60	0.69	0.35	0.43	0.22	0.38	0.65
12	0.39	0.22	1.95	0.72	0.2486	0.1399	1.4052	0.5256	0.51	0.29	0.68	0.68	0.49	0.54	0.40	0.60	0.68
82	0.57	0.45	1.48	0.72	0.4312	0.3704	1.8781	0.5238	0.89	0.77	0.91	0.68	0.86	0.81	0.83	0.90	0.79
54	0.47	0.25	1.89	0.71	0.3266	0.1773	1.4625	0.5214	0.68	0.37	0.70	0.68	0.58	0.61	0.52	0.69	0.69
92	0.34	0.26	1.89	0.71	0.1969	0.1813	1.4621	0.5214	0.41	0.38	0.70	0.68	0.50	0.54	0.39	0.56	0.69
33	0.33	0.23	1.89	0.71	0.1880	0.1572	1.4599	0.5156	0.39	0.33	0.70	0.67	0.47	0.52	0.36	0.55	0.69
27	0.35	0.25	1.92	0.70	0.2062	0.1769	1.4291	0.5120	0.43	0.37	0.69	0.66	0.49	0.54	0.40	0.56	0.68
35	0.20	0.19	2.11	0.70	0.0609	0.1183	1.2446	0.5110	0.13	0.25	0.60	0.66	0.32	0.41	0.19	0.36	0.63
68	0.36	0.25	1.97	0.70	0.2171	0.1700	1.3865	0.5102	0.45	0.36	0.67	0.66	0.49	0.53	0.40	0.56	0.66
89	0.40	0.20	2.21	0.70	0.2570	0.1189	1.1477	0.5062	0.53	0.25	0.55	0.66	0.44	0.50	0.39	0.54	0.60
49	0.24	0.16	2.35	0.70	0.1026	0.0878	1.0004	0.5056	0.21	0.18	0.48	0.65	0.29	0.38	0.20	0.35	0.57
21	0.42	0.31	1.74	0.68	0.2825	0.2335	1.6085	0.4919	0.58	0.49	0.78	0.64	0.62	0.62	0.54	0.68	0.71
55	0.57	0.28	1.69	0.66	0.4291	0.2078	1.6616	0.4718	0.89	0.43	0.80	0.61	0.71	0.68	0.66	0.84	0.71
4	0.49	0.20	1.97	0.66	0.3455	0.1217	1.3868	0.4693	0.71	0.25	0.67	0.61	0.55	0.56	0.48	0.69	0.64
94	0.35	0.38	1.57	0.66	0.2138	0.3049	1.7857	0.4652	0.44	0.64	0.86	0.60	0.65	0.64	0.54	0.65	0.73
90	0.46	0.20	2.17	0.65	0.3156	0.1263	1.1877	0.4580	0.65	0.26	0.57	0.59	0.50	0.52	0.46	0.61	0.58
5	0.19	0.17	2.29	0.65	0.0547	0.0913	1.0595	0.4560	0.11	0.19	0.51	0.59	0.27	0.35	0.15	0.31	0.55
16	0.36	0.18	2.11	0.65	0.2254	0.1062	1.2462	0.4559	0.47	0.22	0.60	0.59	0.43	0.47	0.34	0.53	0.60
20	0.27	0.15	2.28	0.65	0.1313	0.0784	1.0725	0.4545	0.27	0.16	0.52	0.59	0.32	0.39	0.22	0.39	0.55
100	0.28	0.37	1.56	0.64	0.1402	0.2916	1.7884	0.4443	0.29	0.61	0.86	0.58	0.59	0.58	0.45	0.58	0.72
61	0.32	0.17	2.21	0.63	0.1787	0.0948	1.1456	0.4419	0.37	0.20	0.55	0.57	0.37	0.42	0.28	0.46	0.56
63	0.25	0.16	2.31	0.63	0.1101	0.0828	1.0481	0.4416	0.23	0.17	0.51	0.57	0.30	0.37	0.20	0.37	0.54
79	0.45	0.26	1.84	0.63	0.3121	0.1816	1.5142	0.4398	0.65	0.38	0.73	0.57	0.58	0.58	0.51	0.69	0.65
18	0.62	0.24	1.92	0.62	0.4787	0.1594	1.4285	0.4322	0.99	0.33	0.69	0.56	0.67	0.64	0.66	0.84	0.62
29	0.36	0.21	1.98	0.62	0.2160	0.1355	1.3685	0.4322	0.45	0.28	0.66	0.56	0.46	0.49	0.37	0.55	0.61
37	0.18	0.18	2.24	0.62	0.0391	0.1033	1.1159	0.4245	0.08	0.22	0.54	0.55	0.28	0.35	0.15	0.31	0.54
87	0.22	0.17	2.30	0.62	0.0782	0.0905	1.0546	0.4232	0.16	0.19	0.51	0.55	0.29	0.35	0.18	0.33	0.53
34	0.24	0.22	1.91	0.62	0.1036	0.1414	1.4430	0.4231	0.21	0.30	0.70	0.55	0.40	0.44	0.25	0.45	0.62
7	0.50	0.25	1.81	0.61	0.3578	0.1760	1.5439	0.4227	0.74	0.37	0.74	0.55	0.62	0.60	0.55	0.74	0.65

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
52	0.23	0.25	1.92	0.61	0.0930	0.1772	1.4290	0.4181	0.19	0.37	0.69	0.54	0.42	0.45	0.28	0.44	0.61
75	0.41	0.19	2.14	0.61	0.2708	0.1157	1.2165	0.4168	0.56	0.24	0.59	0.54	0.46	0.48	0.40	0.57	0.56
86	0.35	0.25	1.98	0.61	0.2128	0.1720	1.3776	0.4167	0.44	0.36	0.66	0.54	0.49	0.50	0.40	0.55	0.60
73	0.39	0.15	2.51	0.61	0.2476	0.0714	0.8411	0.4161	0.51	0.15	0.41	0.54	0.36	0.40	0.33	0.46	0.47
85	0.40	0.24	1.98	0.60	0.2602	0.1652	1.3713	0.4124	0.54	0.35	0.66	0.53	0.51	0.52	0.44	0.60	0.60
31	0.38	0.19	2.11	0.59	0.2428	0.1182	1.2433	0.3996	0.50	0.25	0.60	0.52	0.45	0.47	0.37	0.55	0.56
9	0.35	0.24	1.83	0.58	0.2129	0.1654	1.5261	0.3917	0.44	0.35	0.74	0.51	0.51	0.51	0.39	0.59	0.62
23	0.26	0.15	2.25	0.58	0.1171	0.0756	1.0994	0.3904	0.24	0.16	0.53	0.51	0.31	0.36	0.20	0.39	0.52
91	0.60	0.47	1.45	0.58	0.4582	0.3930	1.9052	0.3848	0.95	0.82	0.92	0.50	0.90	0.80	0.88	0.93	0.71
93	0.22	0.16	2.42	0.54	0.0808	0.0790	0.9307	0.3449	0.17	0.17	0.45	0.45	0.26	0.31	0.17	0.31	0.45
80	0.26	0.11	2.92	0.53	0.1184	0.0308	0.4366	0.3399	0.24	0.06	0.21	0.44	0.17	0.24	0.15	0.23	0.33
70	0.40	0.19	2.19	0.53	0.2610	0.1142	1.1598	0.3350	0.54	0.24	0.56	0.43	0.45	0.44	0.39	0.55	0.50
51	0.24	0.18	2.15	0.53	0.0969	0.1049	1.2046	0.3329	0.20	0.22	0.58	0.43	0.33	0.36	0.21	0.39	0.51
19	0.43	0.17	2.09	0.52	0.2919	0.0931	1.2642	0.3302	0.60	0.19	0.61	0.43	0.47	0.46	0.40	0.61	0.52
77	0.19	0.15	2.49	0.52	0.0480	0.0784	0.8599	0.3252	0.10	0.16	0.41	0.42	0.23	0.27	0.13	0.26	0.42
96	0.20	0.17	2.19	0.51	0.0647	0.0986	1.1642	0.3169	0.13	0.21	0.56	0.41	0.30	0.33	0.17	0.35	0.49
56	0.34	0.22	1.99	0.51	0.1982	0.1460	1.3609	0.3136	0.41	0.31	0.66	0.41	0.46	0.44	0.36	0.53	0.53
25	0.26	0.18	2.14	0.51	0.1217	0.1048	1.2094	0.3132	0.25	0.22	0.58	0.41	0.35	0.36	0.24	0.42	0.49
39	0.35	0.19	2.16	0.50	0.2095	0.1129	1.1904	0.3097	0.43	0.24	0.57	0.40	0.41	0.41	0.33	0.50	0.49
22	0.20	0.11	2.59	0.50	0.0623	0.0299	0.7662	0.3030	0.13	0.06	0.37	0.39	0.19	0.24	0.10	0.25	0.38
13	0.16	0.13	2.53	0.48	0.0167	0.0569	0.8214	0.2922	0.03	0.12	0.40	0.38	0.18	0.23	0.08	0.22	0.39
10	0.23	0.18	2.16	0.47	0.0935	0.1077	1.1890	0.2788	0.19	0.23	0.57	0.36	0.33	0.34	0.21	0.38	0.47
72	0.26	0.08	3.35	0.45	0.1197	-	-	0.2553	0.25	-	-	0.33	0.08	0.14	0.12	0.12	0.17
88	0.28	0.13	2.56	0.44	0.1372	0.0509	0.7958	0.2511	0.28	0.11	0.38	0.33	0.26	0.27	0.20	0.33	0.35
48	0.18	0.16	2.24	0.44	0.0372	0.0798	1.1100	0.2432	0.08	0.17	0.53	0.31	0.26	0.27	0.12	0.31	0.42
95	0.14	0.14	2.61	0.43	-	0.0652	0.7384	0.2358	-	0.14	0.36	0.31	0.16	0.20	0.07	0.18	0.33
76	0.48	0.17	2.37	0.43	0.3429	0.0919	0.9790	0.2347	0.71	0.19	0.47	0.30	0.46	0.42	0.45	0.59	0.39
8	0.47	0.26	1.83	0.42	0.3263	0.1832	1.5196	0.2269	0.68	0.38	0.73	0.29	0.60	0.52	0.53	0.70	0.51
64	0.37	0.16	2.37	0.42	0.2303	0.0803	0.9830	0.2247	0.48	0.17	0.47	0.29	0.37	0.35	0.32	0.48	0.38
17	0.25	0.09	2.95	0.41	0.1087	0.0171	0.4067	0.2152	0.22	0.04	0.20	0.28	0.15	0.18	0.13	0.21	0.24
74	0.16	0.12	2.26	0.40	0.0238	0.0477	1.0932	0.2118	0.05	0.10	0.53	0.27	0.23	0.24	0.07	0.29	0.40
58	0.32	0.19	2.11	0.40	0.1842	0.1137	1.2447	0.2088	0.38	0.24	0.60	0.27	0.41	0.37	0.31	0.49	0.44
59	0.30	0.21	1.98	0.39	0.1621	0.1351	1.3756	0.1985	0.34	0.28	0.66	0.26	0.43	0.38	0.31	0.50	0.46
2	0.30	0.18	2.17	0.39	0.1626	0.1016	1.1879	0.1966	0.34	0.21	0.57	0.25	0.37	0.34	0.27	0.45	0.41
62	0.36	0.13	2.55	0.38	0.2223	0.0499	0.8038	0.1862	0.46	0.10	0.39	0.24	0.32	0.30	0.28	0.42	0.31
42	0.35	0.20	2.09	0.36	0.2123	0.1200	1.2607	0.1688	0.44	0.25	0.61	0.22	0.43	0.38	0.35	0.52	0.41
40	0.26	0.17	2.20	0.35	0.1175	0.0935	1.1548	0.1613	0.24	0.20	0.56	0.21	0.33	0.30	0.22	0.40	0.38

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
81	0.40	0.23	2.01	0.19	0.2565	0.1502	1.3437	-	0.53	0.31	0.65	-	0.50	0.37	0.42	0.59	0.32

Districts Challenged for Lack of Compactness

District with a Majority of Adult African-American Population

Sorce: United States Census Bureau, 2011 TIGER File and 2010 Redistricting Data File

TABLE 8-F

Virginia 2011 Enacted House of Delegates Redistricting Plan (HB-5005)

Data on Four Measures of Compactness

Sorted by Reock and Polsby-Popper Percentile - High to Low

	Reock	Polsby-Popper	Schwartz-berg	Popula- tion Polygon
Min	0.14	0.08	1.28	0.19
Max	0.62	0.55	3.35	0.96
Mean	0.36	0.24	2.00	0.64
Std. Dev.	0.11	0.09	0.35	0.16

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartz berg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
38	0.62	0.45	1.44	0.84	0.4834	0.3778	1.9093	0.6430	1.00	0.79	0.92	0.83	0.90	0.89	0.89	0.96	0.88
46	0.52	0.55	1.28	0.94	0.3771	0.4785	2.0752	0.7507	0.78	1.00	1.00	0.97	0.93	0.94	0.89	0.89	0.99
91	0.60	0.47	1.45	0.58	0.4582	0.3930	1.9052	0.3848	0.95	0.82	0.92	0.50	0.90	0.80	0.88	0.93	0.71
82	0.57	0.45	1.48	0.72	0.4312	0.3704	1.8781	0.5238	0.89	0.77	0.91	0.68	0.86	0.81	0.83	0.90	0.79
30	0.53	0.36	1.49	0.83	0.3937	0.2882	1.8639	0.6345	0.81	0.60	0.90	0.82	0.77	0.78	0.71	0.86	0.86
15	0.55	0.34	1.52	0.83	0.4072	0.2587	1.8350	0.6339	0.84	0.54	0.88	0.82	0.76	0.77	0.69	0.86	0.85
57	0.45	0.41	1.47	0.96	0.3143	0.3304	1.8815	0.7724	0.65	0.69	0.91	1.00	0.75	0.81	0.67	0.78	0.95
69	0.52	0.34	1.68	0.85	0.3799	0.2646	1.6749	0.6579	0.79	0.55	0.81	0.85	0.72	0.75	0.67	0.80	0.83
83	0.52	0.34	1.69	0.84	0.3769	0.2663	1.6624	0.6479	0.78	0.56	0.80	0.84	0.71	0.74	0.67	0.79	0.82
18	0.62	0.24	1.92	0.62	0.4787	0.1594	1.4285	0.4322	0.99	0.33	0.69	0.56	0.67	0.64	0.66	0.84	0.62
55	0.57	0.28	1.69	0.66	0.4291	0.2078	1.6616	0.4718	0.89	0.43	0.80	0.61	0.71	0.68	0.66	0.84	0.71
11	0.59	0.26	1.80	0.83	0.4483	0.1857	1.5555	0.6381	0.93	0.39	0.75	0.83	0.69	0.72	0.66	0.84	0.79
26	0.46	0.36	1.57	0.85	0.3182	0.2872	1.7839	0.6575	0.66	0.60	0.86	0.85	0.71	0.74	0.63	0.76	0.86
78	0.46	0.35	1.65	0.77	0.3198	0.2778	1.7061	0.5762	0.66	0.58	0.82	0.75	0.69	0.70	0.62	0.74	0.78
50	0.46	0.34	1.62	0.77	0.3178	0.2643	1.7371	0.5808	0.66	0.55	0.84	0.75	0.68	0.70	0.60	0.75	0.79
53	0.46	0.34	1.69	0.77	0.3174	0.2588	1.6609	0.5742	0.66	0.54	0.80	0.74	0.67	0.69	0.60	0.73	0.77
32	0.46	0.31	1.64	0.89	0.3196	0.2320	1.7100	0.6950	0.66	0.48	0.82	0.90	0.66	0.72	0.57	0.74	0.86
7	0.50	0.25	1.81	0.61	0.3578	0.1760	1.5439	0.4227	0.74	0.37	0.74	0.55	0.62	0.60	0.55	0.74	0.65
44	0.43	0.32	1.69	0.87	0.2915	0.2411	1.6626	0.6757	0.60	0.50	0.80	0.87	0.64	0.70	0.55	0.70	0.84
47	0.41	0.33	1.73	0.76	0.2720	0.2514	1.6265	0.5684	0.56	0.53	0.78	0.74	0.62	0.65	0.54	0.67	0.76
94	0.35	0.38	1.57	0.66	0.2138	0.3049	1.7857	0.4652	0.44	0.64	0.86	0.60	0.65	0.64	0.54	0.65	0.73
21	0.42	0.31	1.74	0.68	0.2825	0.2335	1.6085	0.4919	0.58	0.49	0.78	0.64	0.62	0.62	0.54	0.68	0.71
36	0.43	0.30	1.66	0.76	0.2875	0.2280	1.6885	0.5706	0.59	0.48	0.81	0.74	0.63	0.66	0.54	0.70	0.78
8	0.47	0.26	1.83	0.42	0.3263	0.1832	1.5196	0.2269	0.68	0.38	0.73	0.29	0.60	0.52	0.53	0.70	0.51
54	0.47	0.25	1.89	0.71	0.3266	0.1773	1.4625	0.5214	0.68	0.37	0.70	0.68	0.58	0.61	0.52	0.69	0.69

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
79	0.45	0.26	1.84	0.63	0.3121	0.1816	1.5142	0.4398	0.65	0.38	0.73	0.57	0.58	0.58	0.51	0.69	0.65
84	0.44	0.26	1.89	0.75	0.2999	0.1808	1.4640	0.5564	0.62	0.38	0.71	0.72	0.57	0.61	0.50	0.66	0.71
60	0.38	0.31	1.62	0.77	0.2411	0.2370	1.7332	0.5736	0.50	0.50	0.84	0.74	0.61	0.64	0.50	0.67	0.79
24	0.44	0.25	1.78	0.78	0.3038	0.1711	1.5727	0.5845	0.63	0.36	0.76	0.76	0.58	0.63	0.49	0.69	0.76
4	0.49	0.20	1.97	0.66	0.3455	0.1217	1.3868	0.4693	0.71	0.25	0.67	0.61	0.55	0.56	0.48	0.69	0.64
41	0.36	0.32	1.72	0.75	0.2184	0.2443	1.6348	0.5531	0.45	0.51	0.79	0.72	0.58	0.62	0.48	0.62	0.75
90	0.46	0.20	2.17	0.65	0.3156	0.1263	1.1877	0.4580	0.65	0.26	0.57	0.59	0.50	0.52	0.46	0.61	0.58
76	0.48	0.17	2.37	0.43	0.3429	0.0919	0.9790	0.2347	0.71	0.19	0.47	0.30	0.46	0.42	0.45	0.59	0.39
100	0.28	0.37	1.56	0.64	0.1402	0.2916	1.7884	0.4443	0.29	0.61	0.86	0.58	0.59	0.58	0.45	0.58	0.72
28	0.39	0.26	1.82	0.75	0.2481	0.1803	1.5285	0.5569	0.51	0.38	0.74	0.72	0.54	0.59	0.44	0.62	0.73
85	0.40	0.24	1.98	0.60	0.2602	0.1652	1.3713	0.4124	0.54	0.35	0.66	0.53	0.51	0.52	0.44	0.60	0.60
65	0.37	0.27	1.82	0.77	0.2286	0.1937	1.5345	0.5810	0.47	0.40	0.74	0.75	0.54	0.59	0.44	0.61	0.75
97	0.43	0.21	1.73	0.85	0.2856	0.1343	1.6267	0.6558	0.59	0.28	0.78	0.85	0.55	0.63	0.44	0.69	0.82
81	0.40	0.23	2.01	0.19	0.2565	0.1502	1.3437	-	0.53	0.31	0.65	-	0.50	0.37	0.42	0.59	0.32
12	0.39	0.22	1.95	0.72	0.2486	0.1399	1.4052	0.5256	0.51	0.29	0.68	0.68	0.49	0.54	0.40	0.60	0.68
68	0.36	0.25	1.97	0.70	0.2171	0.1700	1.3865	0.5102	0.45	0.36	0.67	0.66	0.49	0.53	0.40	0.56	0.66
75	0.41	0.19	2.14	0.61	0.2708	0.1157	1.2165	0.4168	0.56	0.24	0.59	0.54	0.46	0.48	0.40	0.57	0.56
86	0.35	0.25	1.98	0.61	0.2128	0.1720	1.3776	0.4167	0.44	0.36	0.66	0.54	0.49	0.50	0.40	0.55	0.60
19	0.43	0.17	2.09	0.52	0.2919	0.0931	1.2642	0.3302	0.60	0.19	0.61	0.43	0.47	0.46	0.40	0.61	0.52
27	0.35	0.25	1.92	0.70	0.2062	0.1769	1.4291	0.5120	0.43	0.37	0.69	0.66	0.49	0.54	0.40	0.56	0.68
92	0.34	0.26	1.89	0.71	0.1969	0.1813	1.4621	0.5214	0.41	0.38	0.70	0.68	0.50	0.54	0.39	0.56	0.69
9	0.35	0.24	1.83	0.58	0.2129	0.1654	1.5261	0.3917	0.44	0.35	0.74	0.51	0.51	0.51	0.39	0.59	0.62
89	0.40	0.20	2.21	0.70	0.2570	0.1189	1.1477	0.5062	0.53	0.25	0.55	0.66	0.44	0.50	0.39	0.54	0.60
70	0.40	0.19	2.19	0.53	0.2610	0.1142	1.1598	0.3350	0.54	0.24	0.56	0.43	0.45	0.44	0.39	0.55	0.50
66	0.31	0.27	1.79	0.74	0.1715	0.1913	1.5618	0.5496	0.35	0.40	0.75	0.71	0.50	0.55	0.38	0.55	0.73
31	0.38	0.19	2.11	0.59	0.2428	0.1182	1.2433	0.3996	0.50	0.25	0.60	0.52	0.45	0.47	0.37	0.55	0.56
67	0.32	0.25	1.84	0.77	0.1809	0.1757	1.5148	0.5734	0.37	0.37	0.73	0.74	0.49	0.55	0.37	0.55	0.74
71	0.33	0.24	1.99	0.77	0.1933	0.1627	1.3660	0.5798	0.40	0.34	0.66	0.75	0.47	0.54	0.37	0.53	0.70
29	0.36	0.21	1.98	0.62	0.2160	0.1355	1.3685	0.4322	0.45	0.28	0.66	0.56	0.46	0.49	0.37	0.55	0.61
1	0.26	0.30	1.69	0.91	0.1244	0.2257	1.6658	0.7185	0.26	0.47	0.80	0.93	0.51	0.62	0.36	0.53	0.87
33	0.33	0.23	1.89	0.71	0.1880	0.1572	1.4599	0.5156	0.39	0.33	0.70	0.67	0.47	0.52	0.36	0.55	0.69
56	0.34	0.22	1.99	0.51	0.1982	0.1460	1.3609	0.3136	0.41	0.31	0.66	0.41	0.46	0.44	0.36	0.53	0.53
45	0.29	0.26	1.81	0.73	0.1544	0.1806	1.5425	0.5406	0.32	0.38	0.74	0.70	0.48	0.54	0.35	0.53	0.72
42	0.35	0.20	2.09	0.36	0.2123	0.1200	1.2607	0.1688	0.44	0.25	0.61	0.22	0.43	0.38	0.35	0.52	0.41
16	0.36	0.18	2.11	0.65	0.2254	0.1062	1.2462	0.4559	0.47	0.22	0.60	0.59	0.43	0.47	0.34	0.53	0.60
98	0.28	0.26	1.78	0.78	0.1402	0.1858	1.5760	0.5837	0.29	0.39	0.76	0.76	0.48	0.55	0.34	0.52	0.76
39	0.35	0.19	2.16	0.50	0.2095	0.1129	1.1904	0.3097	0.43	0.24	0.57	0.40	0.41	0.41	0.33	0.50	0.49

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
73	0.39	0.15	2.51	0.61	0.2476	0.0714	0.8411	0.4161	0.51	0.15	0.41	0.54	0.36	0.40	0.33	0.46	0.47
64	0.37	0.16	2.37	0.42	0.2303	0.0803	0.9830	0.2247	0.48	0.17	0.47	0.29	0.37	0.35	0.32	0.48	0.38
6	0.27	0.26	1.82	0.75	0.1259	0.1825	1.5311	0.5561	0.26	0.38	0.74	0.72	0.46	0.52	0.32	0.50	0.73
58	0.32	0.19	2.11	0.40	0.1842	0.1137	1.2447	0.2088	0.38	0.24	0.60	0.27	0.41	0.37	0.31	0.49	0.44
59	0.30	0.21	1.98	0.39	0.1621	0.1351	1.3756	0.1985	0.34	0.28	0.66	0.26	0.43	0.38	0.31	0.50	0.46
3	0.28	0.21	1.84	0.93	0.1440	0.1373	1.5150	0.7363	0.30	0.29	0.73	0.95	0.44	0.57	0.29	0.51	0.84
61	0.32	0.17	2.21	0.63	0.1787	0.0948	1.1456	0.4419	0.37	0.20	0.55	0.57	0.37	0.42	0.28	0.46	0.56
62	0.36	0.13	2.55	0.38	0.2223	0.0499	0.8038	0.1862	0.46	0.10	0.39	0.24	0.32	0.30	0.28	0.42	0.31
52	0.23	0.25	1.92	0.61	0.0930	0.1772	1.4290	0.4181	0.19	0.37	0.69	0.54	0.42	0.45	0.28	0.44	0.61
99	0.27	0.21	1.97	0.82	0.1286	0.1355	1.3822	0.6320	0.27	0.28	0.67	0.82	0.41	0.51	0.27	0.47	0.74
2	0.30	0.18	2.17	0.39	0.1626	0.1016	1.1879	0.1966	0.34	0.21	0.57	0.25	0.37	0.34	0.27	0.45	0.41
34	0.24	0.22	1.91	0.62	0.1036	0.1414	1.4430	0.4231	0.21	0.30	0.70	0.55	0.40	0.44	0.25	0.45	0.62
25	0.26	0.18	2.14	0.51	0.1217	0.1048	1.2094	0.3132	0.25	0.22	0.58	0.41	0.35	0.36	0.24	0.42	0.49
43	0.22	0.21	2.10	0.72	0.0807	0.1330	1.2501	0.5323	0.17	0.28	0.60	0.69	0.35	0.43	0.22	0.38	0.65
40	0.26	0.17	2.20	0.35	0.1175	0.0935	1.1548	0.1613	0.24	0.20	0.56	0.21	0.33	0.30	0.22	0.40	0.38
20	0.27	0.15	2.28	0.65	0.1313	0.0784	1.0725	0.4545	0.27	0.16	0.52	0.59	0.32	0.39	0.22	0.39	0.55
51	0.24	0.18	2.15	0.53	0.0969	0.1049	1.2046	0.3329	0.20	0.22	0.58	0.43	0.33	0.36	0.21	0.39	0.51
10	0.23	0.18	2.16	0.47	0.0935	0.1077	1.1890	0.2788	0.19	0.23	0.57	0.36	0.33	0.34	0.21	0.38	0.47
63	0.25	0.16	2.31	0.63	0.1101	0.0828	1.0481	0.4416	0.23	0.17	0.51	0.57	0.30	0.37	0.20	0.37	0.54
23	0.26	0.15	2.25	0.58	0.1171	0.0756	1.0994	0.3904	0.24	0.16	0.53	0.51	0.31	0.36	0.20	0.39	0.52
49	0.24	0.16	2.35	0.70	0.1026	0.0878	1.0004	0.5056	0.21	0.18	0.48	0.65	0.29	0.38	0.20	0.35	0.57
88	0.28	0.13	2.56	0.44	0.1372	0.0509	0.7958	0.2511	0.28	0.11	0.38	0.33	0.26	0.27	0.20	0.33	0.35
14	0.24	0.16	2.34	0.76	0.0972	0.0829	1.0180	0.5682	0.20	0.17	0.49	0.74	0.29	0.40	0.19	0.35	0.61
35	0.20	0.19	2.11	0.70	0.0609	0.1183	1.2446	0.5110	0.13	0.25	0.60	0.66	0.32	0.41	0.19	0.36	0.63
87	0.22	0.17	2.30	0.62	0.0782	0.0905	1.0546	0.4232	0.16	0.19	0.51	0.55	0.29	0.35	0.18	0.33	0.53
96	0.20	0.17	2.19	0.51	0.0647	0.0986	1.1642	0.3169	0.13	0.21	0.56	0.41	0.30	0.33	0.17	0.35	0.49
93	0.22	0.16	2.42	0.54	0.0808	0.0790	0.9307	0.3449	0.17	0.17	0.45	0.45	0.26	0.31	0.17	0.31	0.45
80	0.26	0.11	2.92	0.53	0.1184	0.0308	0.4366	0.3399	0.24	0.06	0.21	0.44	0.17	0.24	0.15	0.23	0.33
5	0.19	0.17	2.29	0.65	0.0547	0.0913	1.0595	0.4560	0.11	0.19	0.51	0.59	0.27	0.35	0.15	0.31	0.55
37	0.18	0.18	2.24	0.62	0.0391	0.1033	1.1159	0.4245	0.08	0.22	0.54	0.55	0.28	0.35	0.15	0.31	0.54
77	0.19	0.15	2.49	0.52	0.0480	0.0784	0.8599	0.3252	0.10	0.16	0.41	0.42	0.23	0.27	0.13	0.26	0.42
17	0.25	0.09	2.95	0.41	0.1087	0.0171	0.4067	0.2152	0.22	0.04	0.20	0.28	0.15	0.18	0.13	0.21	0.24
72	0.26	0.08	3.35	0.45	0.1197	-	-	0.2553	0.25	-	-	0.33	0.08	0.14	0.12	0.12	0.17
48	0.18	0.16	2.24	0.44	0.0372	0.0798	1.1100	0.2432	0.08	0.17	0.53	0.31	0.26	0.27	0.12	0.31	0.42
22	0.20	0.11	2.59	0.50	0.0623	0.0299	0.7662	0.3030	0.13	0.06	0.37	0.39	0.19	0.24	0.10	0.25	0.38
13	0.16	0.13	2.53	0.48	0.0167	0.0569	0.8214	0.2922	0.03	0.12	0.40	0.38	0.18	0.23	0.08	0.22	0.39
74	0.16	0.12	2.26	0.40	0.0238	0.0477	1.0932	0.2118	0.05	0.10	0.53	0.27	0.23	0.24	0.07	0.29	0.40

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
95	0.14	0.14	2.61	0.43	-	0.0652	0.7384	0.2358	-	0.14	0.36	0.31	0.16	0.20	0.07	0.18	0.33

Districts Challenged for Lack of Compactness

District with a Majority of Adult African-American Population

Sorce: United States Census Bureau, 2011 TIGER File and 2010 Redistricting Data File

TABLE 8-G

Virginia 2011 Enacted House of Delegates Redistricting Plan (HB-5005)

Data on Four Measures of Compactness

Sorted by Population-Polygon and Schwartzberg Average Percentiles - High to Low

	Reock	Polsby-Popper	Schwartz-berg	Popula- tion Polygon
Min	0.14	0.08	1.28	0.19
Max	0.62	0.55	3.35	0.96
Mean	0.36	0.24	2.00	0.64
Std. Dev.	0.11	0.09	0.35	0.16

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartz berg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
46	0.52	0.55	1.28	0.94	0.3771	0.4785	2.0752	0.7507	0.78	1.00	1.00	0.97	0.93	0.94	0.89	0.89	0.99
57	0.45	0.41	1.47	0.96	0.3143	0.3304	1.8815	0.7724	0.65	0.69	0.91	1.00	0.75	0.81	0.67	0.78	0.95
38	0.62	0.45	1.44	0.84	0.4834	0.3778	1.9093	0.6430	1.00	0.79	0.92	0.83	0.90	0.89	0.89	0.96	0.88
1	0.26	0.30	1.69	0.91	0.1244	0.2257	1.6658	0.7185	0.26	0.47	0.80	0.93	0.51	0.62	0.36	0.53	0.87
32	0.46	0.31	1.64	0.89	0.3196	0.2320	1.7100	0.6950	0.66	0.48	0.82	0.90	0.66	0.72	0.57	0.74	0.86
30	0.53	0.36	1.49	0.83	0.3937	0.2882	1.8639	0.6345	0.81	0.60	0.90	0.82	0.77	0.78	0.71	0.86	0.86
26	0.46	0.36	1.57	0.85	0.3182	0.2872	1.7839	0.6575	0.66	0.60	0.86	0.85	0.71	0.74	0.63	0.76	0.86
15	0.55	0.34	1.52	0.83	0.4072	0.2587	1.8350	0.6339	0.84	0.54	0.88	0.82	0.76	0.77	0.69	0.86	0.85
3	0.28	0.21	1.84	0.93	0.1440	0.1373	1.5150	0.7363	0.30	0.29	0.73	0.95	0.44	0.57	0.29	0.51	0.84
44	0.43	0.32	1.69	0.87	0.2915	0.2411	1.6626	0.6757	0.60	0.50	0.80	0.87	0.64	0.70	0.55	0.70	0.84
69	0.52	0.34	1.68	0.85	0.3799	0.2646	1.6749	0.6579	0.79	0.55	0.81	0.85	0.72	0.75	0.67	0.80	0.83
83	0.52	0.34	1.69	0.84	0.3769	0.2663	1.6624	0.6479	0.78	0.56	0.80	0.84	0.71	0.74	0.67	0.79	0.82
97	0.43	0.21	1.73	0.85	0.2856	0.1343	1.6267	0.6558	0.59	0.28	0.78	0.85	0.55	0.63	0.44	0.69	0.82
50	0.46	0.34	1.62	0.77	0.3178	0.2643	1.7371	0.5808	0.66	0.55	0.84	0.75	0.68	0.70	0.60	0.75	0.79
82	0.57	0.45	1.48	0.72	0.4312	0.3704	1.8781	0.5238	0.89	0.77	0.91	0.68	0.86	0.81	0.83	0.90	0.79
60	0.38	0.31	1.62	0.77	0.2411	0.2370	1.7332	0.5736	0.50	0.50	0.84	0.74	0.61	0.64	0.50	0.67	0.79
11	0.59	0.26	1.80	0.83	0.4483	0.1857	1.5555	0.6381	0.93	0.39	0.75	0.83	0.69	0.72	0.66	0.84	0.79
78	0.46	0.35	1.65	0.77	0.3198	0.2778	1.7061	0.5762	0.66	0.58	0.82	0.75	0.69	0.70	0.62	0.74	0.78
36	0.43	0.30	1.66	0.76	0.2875	0.2280	1.6885	0.5706	0.59	0.48	0.81	0.74	0.63	0.66	0.54	0.70	0.78
53	0.46	0.34	1.69	0.77	0.3174	0.2588	1.6609	0.5742	0.66	0.54	0.80	0.74	0.67	0.69	0.60	0.73	0.77
47	0.41	0.33	1.73	0.76	0.2720	0.2514	1.6265	0.5684	0.56	0.53	0.78	0.74	0.62	0.65	0.54	0.67	0.76
98	0.28	0.26	1.78	0.78	0.1402	0.1858	1.5760	0.5837	0.29	0.39	0.76	0.76	0.48	0.55	0.34	0.52	0.76
24	0.44	0.25	1.78	0.78	0.3038	0.1711	1.5727	0.5845	0.63	0.36	0.76	0.76	0.58	0.63	0.49	0.69	0.76
41	0.36	0.32	1.72	0.75	0.2184	0.2443	1.6348	0.5531	0.45	0.51	0.79	0.72	0.58	0.62	0.48	0.62	0.75
65	0.37	0.27	1.82	0.77	0.2286	0.1937	1.5345	0.5810	0.47	0.40	0.74	0.75	0.54	0.59	0.44	0.61	0.75

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
99	0.27	0.21	1.97	0.82	0.1286	0.1355	1.3822	0.6320	0.27	0.28	0.67	0.82	0.41	0.51	0.27	0.47	0.74
67	0.32	0.25	1.84	0.77	0.1809	0.1757	1.5148	0.5734	0.37	0.37	0.73	0.74	0.49	0.55	0.37	0.55	0.74
66	0.31	0.27	1.79	0.74	0.1715	0.1913	1.5618	0.5496	0.35	0.40	0.75	0.71	0.50	0.55	0.38	0.55	0.73
94	0.35	0.38	1.57	0.66	0.2138	0.3049	1.7857	0.4652	0.44	0.64	0.86	0.60	0.65	0.64	0.54	0.65	0.73
6	0.27	0.26	1.82	0.75	0.1259	0.1825	1.5311	0.5561	0.26	0.38	0.74	0.72	0.46	0.52	0.32	0.50	0.73
28	0.39	0.26	1.82	0.75	0.2481	0.1803	1.5285	0.5569	0.51	0.38	0.74	0.72	0.54	0.59	0.44	0.62	0.73
45	0.29	0.26	1.81	0.73	0.1544	0.1806	1.5425	0.5406	0.32	0.38	0.74	0.70	0.48	0.54	0.35	0.53	0.72
100	0.28	0.37	1.56	0.64	0.1402	0.2916	1.7884	0.4443	0.29	0.61	0.86	0.58	0.59	0.58	0.45	0.58	0.72
84	0.44	0.26	1.89	0.75	0.2999	0.1808	1.4640	0.5564	0.62	0.38	0.71	0.72	0.57	0.61	0.50	0.66	0.71
91	0.60	0.47	1.45	0.58	0.4582	0.3930	1.9052	0.3848	0.95	0.82	0.92	0.50	0.90	0.80	0.88	0.93	0.71
21	0.42	0.31	1.74	0.68	0.2825	0.2335	1.6085	0.4919	0.58	0.49	0.78	0.64	0.62	0.62	0.54	0.68	0.71
55	0.57	0.28	1.69	0.66	0.4291	0.2078	1.6616	0.4718	0.89	0.43	0.80	0.61	0.71	0.68	0.66	0.84	0.71
71	0.33	0.24	1.99	0.77	0.1933	0.1627	1.3660	0.5798	0.40	0.34	0.66	0.75	0.47	0.54	0.37	0.53	0.70
54	0.47	0.25	1.89	0.71	0.3266	0.1773	1.4625	0.5214	0.68	0.37	0.70	0.68	0.58	0.61	0.52	0.69	0.69
92	0.34	0.26	1.89	0.71	0.1969	0.1813	1.4621	0.5214	0.41	0.38	0.70	0.68	0.50	0.54	0.39	0.56	0.69
33	0.33	0.23	1.89	0.71	0.1880	0.1572	1.4599	0.5156	0.39	0.33	0.70	0.67	0.47	0.52	0.36	0.55	0.69
12	0.39	0.22	1.95	0.72	0.2486	0.1399	1.4052	0.5256	0.51	0.29	0.68	0.68	0.49	0.54	0.40	0.60	0.68
27	0.35	0.25	1.92	0.70	0.2062	0.1769	1.4291	0.5120	0.43	0.37	0.69	0.66	0.49	0.54	0.40	0.56	0.68
68	0.36	0.25	1.97	0.70	0.2171	0.1700	1.3865	0.5102	0.45	0.36	0.67	0.66	0.49	0.53	0.40	0.56	0.66
79	0.45	0.26	1.84	0.63	0.3121	0.1816	1.5142	0.4398	0.65	0.38	0.73	0.57	0.58	0.58	0.51	0.69	0.65
43	0.22	0.21	2.10	0.72	0.0807	0.1330	1.2501	0.5323	0.17	0.28	0.60	0.69	0.35	0.43	0.22	0.38	0.65
7	0.50	0.25	1.81	0.61	0.3578	0.1760	1.5439	0.4227	0.74	0.37	0.74	0.55	0.62	0.60	0.55	0.74	0.65
4	0.49	0.20	1.97	0.66	0.3455	0.1217	1.3868	0.4693	0.71	0.25	0.67	0.61	0.55	0.56	0.48	0.69	0.64
35	0.20	0.19	2.11	0.70	0.0609	0.1183	1.2446	0.5110	0.13	0.25	0.60	0.66	0.32	0.41	0.19	0.36	0.63
18	0.62	0.24	1.92	0.62	0.4787	0.1594	1.4285	0.4322	0.99	0.33	0.69	0.56	0.67	0.64	0.66	0.84	0.62
34	0.24	0.22	1.91	0.62	0.1036	0.1414	1.4430	0.4231	0.21	0.30	0.70	0.55	0.40	0.44	0.25	0.45	0.62
9	0.35	0.24	1.83	0.58	0.2129	0.1654	1.5261	0.3917	0.44	0.35	0.74	0.51	0.51	0.51	0.39	0.59	0.62
52	0.23	0.25	1.92	0.61	0.0930	0.1772	1.4290	0.4181	0.19	0.37	0.69	0.54	0.42	0.45	0.28	0.44	0.61
14	0.24	0.16	2.34	0.76	0.0972	0.0829	1.0180	0.5682	0.20	0.17	0.49	0.74	0.29	0.40	0.19	0.35	0.61
29	0.36	0.21	1.98	0.62	0.2160	0.1355	1.3685	0.4322	0.45	0.28	0.66	0.56	0.46	0.49	0.37	0.55	0.61
89	0.40	0.20	2.21	0.70	0.2570	0.1189	1.1477	0.5062	0.53	0.25	0.55	0.66	0.44	0.50	0.39	0.54	0.60
86	0.35	0.25	1.98	0.61	0.2128	0.1720	1.3776	0.4167	0.44	0.36	0.66	0.54	0.49	0.50	0.40	0.55	0.60
85	0.40	0.24	1.98	0.60	0.2602	0.1652	1.3713	0.4124	0.54	0.35	0.66	0.53	0.51	0.52	0.44	0.60	0.60
16	0.36	0.18	2.11	0.65	0.2254	0.1062	1.2462	0.4559	0.47	0.22	0.60	0.59	0.43	0.47	0.34	0.53	0.60
90	0.46	0.20	2.17	0.65	0.3156	0.1263	1.1877	0.4580	0.65	0.26	0.57	0.59	0.50	0.52	0.46	0.61	0.58
49	0.24	0.16	2.35	0.70	0.1026	0.0878	1.0004	0.5056	0.21	0.18	0.48	0.65	0.29	0.38	0.20	0.35	0.57
75	0.41	0.19	2.14	0.61	0.2708	0.1157	1.2165	0.4168	0.56	0.24	0.59	0.54	0.46	0.48	0.40	0.57	0.56

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
61	0.32	0.17	2.21	0.63	0.1787	0.0948	1.1456	0.4419	0.37	0.20	0.55	0.57	0.37	0.42	0.28	0.46	0.56
31	0.38	0.19	2.11	0.59	0.2428	0.1182	1.2433	0.3996	0.50	0.25	0.60	0.52	0.45	0.47	0.37	0.55	0.56
20	0.27	0.15	2.28	0.65	0.1313	0.0784	1.0725	0.4545	0.27	0.16	0.52	0.59	0.32	0.39	0.22	0.39	0.55
5	0.19	0.17	2.29	0.65	0.0547	0.0913	1.0595	0.4560	0.11	0.19	0.51	0.59	0.27	0.35	0.15	0.31	0.55
37	0.18	0.18	2.24	0.62	0.0391	0.1033	1.1159	0.4245	0.08	0.22	0.54	0.55	0.28	0.35	0.15	0.31	0.54
63	0.25	0.16	2.31	0.63	0.1101	0.0828	1.0481	0.4416	0.23	0.17	0.51	0.57	0.30	0.37	0.20	0.37	0.54
56	0.34	0.22	1.99	0.51	0.1982	0.1460	1.3609	0.3136	0.41	0.31	0.66	0.41	0.46	0.44	0.36	0.53	0.53
87	0.22	0.17	2.30	0.62	0.0782	0.0905	1.0546	0.4232	0.16	0.19	0.51	0.55	0.29	0.35	0.18	0.33	0.53
19	0.43	0.17	2.09	0.52	0.2919	0.0931	1.2642	0.3302	0.60	0.19	0.61	0.43	0.47	0.46	0.40	0.61	0.52
23	0.26	0.15	2.25	0.58	0.1171	0.0756	1.0994	0.3904	0.24	0.16	0.53	0.51	0.31	0.36	0.20	0.39	0.52
8	0.47	0.26	1.83	0.42	0.3263	0.1832	1.5196	0.2269	0.68	0.38	0.73	0.29	0.60	0.52	0.53	0.70	0.51
51	0.24	0.18	2.15	0.53	0.0969	0.1049	1.2046	0.3329	0.20	0.22	0.58	0.43	0.33	0.36	0.21	0.39	0.51
70	0.40	0.19	2.19	0.53	0.2610	0.1142	1.1598	0.3350	0.54	0.24	0.56	0.43	0.45	0.44	0.39	0.55	0.50
25	0.26	0.18	2.14	0.51	0.1217	0.1048	1.2094	0.3132	0.25	0.22	0.58	0.41	0.35	0.36	0.24	0.42	0.49
39	0.35	0.19	2.16	0.50	0.2095	0.1129	1.1904	0.3097	0.43	0.24	0.57	0.40	0.41	0.41	0.33	0.50	0.49
96	0.20	0.17	2.19	0.51	0.0647	0.0986	1.1642	0.3169	0.13	0.21	0.56	0.41	0.30	0.33	0.17	0.35	0.49
73	0.39	0.15	2.51	0.61	0.2476	0.0714	0.8411	0.4161	0.51	0.15	0.41	0.54	0.36	0.40	0.33	0.46	0.47
10	0.23	0.18	2.16	0.47	0.0935	0.1077	1.1890	0.2788	0.19	0.23	0.57	0.36	0.33	0.34	0.21	0.38	0.47
59	0.30	0.21	1.98	0.39	0.1621	0.1351	1.3756	0.1985	0.34	0.28	0.66	0.26	0.43	0.38	0.31	0.50	0.46
93	0.22	0.16	2.42	0.54	0.0808	0.0790	0.9307	0.3449	0.17	0.17	0.45	0.45	0.26	0.31	0.17	0.31	0.45
58	0.32	0.19	2.11	0.40	0.1842	0.1137	1.2447	0.2088	0.38	0.24	0.60	0.27	0.41	0.37	0.31	0.49	0.44
48	0.18	0.16	2.24	0.44	0.0372	0.0798	1.1100	0.2432	0.08	0.17	0.53	0.31	0.26	0.27	0.12	0.31	0.42
77	0.19	0.15	2.49	0.52	0.0480	0.0784	0.8599	0.3252	0.10	0.16	0.41	0.42	0.23	0.27	0.13	0.26	0.42
2	0.30	0.18	2.17	0.39	0.1626	0.1016	1.1879	0.1966	0.34	0.21	0.57	0.25	0.37	0.34	0.27	0.45	0.41
42	0.35	0.20	2.09	0.36	0.2123	0.1200	1.2607	0.1688	0.44	0.25	0.61	0.22	0.43	0.38	0.35	0.52	0.41
74	0.16	0.12	2.26	0.40	0.0238	0.0477	1.0932	0.2118	0.05	0.10	0.53	0.27	0.23	0.24	0.07	0.29	0.40
76	0.48	0.17	2.37	0.43	0.3429	0.0919	0.9790	0.2347	0.71	0.19	0.47	0.30	0.46	0.42	0.45	0.59	0.39
13	0.16	0.13	2.53	0.48	0.0167	0.0569	0.8214	0.2922	0.03	0.12	0.40	0.38	0.18	0.23	0.08	0.22	0.39
40	0.26	0.17	2.20	0.35	0.1175	0.0935	1.1548	0.1613	0.24	0.20	0.56	0.21	0.33	0.30	0.22	0.40	0.38
64	0.37	0.16	2.37	0.42	0.2303	0.0803	0.9830	0.2247	0.48	0.17	0.47	0.29	0.37	0.35	0.32	0.48	0.38
22	0.20	0.11	2.59	0.50	0.0623	0.0299	0.7662	0.3030	0.13	0.06	0.37	0.39	0.19	0.24	0.10	0.25	0.38
88	0.28	0.13	2.56	0.44	0.1372	0.0509	0.7958	0.2511	0.28	0.11	0.38	0.33	0.26	0.27	0.20	0.33	0.35
95	0.14	0.14	2.61	0.43	-	0.0652	0.7384	0.2358	-	0.14	0.36	0.31	0.16	0.20	0.07	0.18	0.33
80	0.26	0.11	2.92	0.53	0.1184	0.0308	0.4366	0.3399	0.24	0.06	0.21	0.44	0.17	0.24	0.15	0.23	0.33
81	0.40	0.23	2.01	0.19	0.2565	0.1502	1.3437	-	0.53	0.31	0.65	-	0.50	0.37	0.42	0.59	0.32
62	0.36	0.13	2.55	0.38	0.2223	0.0499	0.8038	0.1862	0.46	0.10	0.39	0.24	0.32	0.30	0.28	0.42	0.31
17	0.25	0.09	2.95	0.41	0.1087	0.0171	0.4067	0.2152	0.22	0.04	0.20	0.28	0.15	0.18	0.13	0.21	0.24

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
72	0.26	0.08	3.35	0.45	0.1197	-	-	0.2553	0.25	-	-	0.33	0.08	0.14	0.12	0.12	0.17

Districts Challenged for Lack of Compactness

District with a Majority of Adult African-American Population

Sorce: United States Census Bureau, 2011 TIGER File and 2010 Redistricting Data File

TABLE 8-H

Virginia 2011 Enacted House of Delegates Redistricting Plan (HB-5005)

Data on Four Measures of Compactness

Sorted by Reock, Schwartzburg, Population-Polygon and Polsby-Popper Average Percentiles - High to Low

	Reock	Polsby-Popper	Schwartz-berg	Popula- tion Polygon
Min	0.14	0.08	1.28	0.19
Max	0.62	0.55	3.35	0.96
Mean	0.36	0.24	2.00	0.64
Std. Dev.	0.11	0.09	0.35	0.16

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartz berg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
46	0.52	0.55	1.28	0.94	0.3771	0.4785	2.0752	0.7507	0.78	1.00	1.00	0.97	0.93	0.94	0.89	0.89	0.99
38	0.62	0.45	1.44	0.84	0.4834	0.3778	1.9093	0.6430	1.00	0.79	0.92	0.83	0.90	0.89	0.89	0.96	0.88
82	0.57	0.45	1.48	0.72	0.4312	0.3704	1.8781	0.5238	0.89	0.77	0.91	0.68	0.86	0.81	0.83	0.90	0.79
57	0.45	0.41	1.47	0.96	0.3143	0.3304	1.8815	0.7724	0.65	0.69	0.91	1.00	0.75	0.81	0.67	0.78	0.95
91	0.60	0.47	1.45	0.58	0.4582	0.3930	1.9052	0.3848	0.95	0.82	0.92	0.50	0.90	0.80	0.88	0.93	0.71
30	0.53	0.36	1.49	0.83	0.3937	0.2882	1.8639	0.6345	0.81	0.60	0.90	0.82	0.77	0.78	0.71	0.86	0.86
15	0.55	0.34	1.52	0.83	0.4072	0.2587	1.8350	0.6339	0.84	0.54	0.88	0.82	0.76	0.77	0.69	0.86	0.85
69	0.52	0.34	1.68	0.85	0.3799	0.2646	1.6749	0.6579	0.79	0.55	0.81	0.85	0.72	0.75	0.67	0.80	0.83
83	0.52	0.34	1.69	0.84	0.3769	0.2663	1.6624	0.6479	0.78	0.56	0.80	0.84	0.71	0.74	0.67	0.79	0.82
26	0.46	0.36	1.57	0.85	0.3182	0.2872	1.7839	0.6575	0.66	0.60	0.86	0.85	0.71	0.74	0.63	0.76	0.86
11	0.59	0.26	1.80	0.83	0.4483	0.1857	1.5555	0.6381	0.93	0.39	0.75	0.83	0.69	0.72	0.66	0.84	0.79
32	0.46	0.31	1.64	0.89	0.3196	0.2320	1.7100	0.6950	0.66	0.48	0.82	0.90	0.66	0.72	0.57	0.74	0.86
78	0.46	0.35	1.65	0.77	0.3198	0.2778	1.7061	0.5762	0.66	0.58	0.82	0.75	0.69	0.70	0.62	0.74	0.78
50	0.46	0.34	1.62	0.77	0.3178	0.2643	1.7371	0.5808	0.66	0.55	0.84	0.75	0.68	0.70	0.60	0.75	0.79
44	0.43	0.32	1.69	0.87	0.2915	0.2411	1.6626	0.6757	0.60	0.50	0.80	0.87	0.64	0.70	0.55	0.70	0.84
53	0.46	0.34	1.69	0.77	0.3174	0.2588	1.6609	0.5742	0.66	0.54	0.80	0.74	0.67	0.69	0.60	0.73	0.77
55	0.57	0.28	1.69	0.66	0.4291	0.2078	1.6616	0.4718	0.89	0.43	0.80	0.61	0.71	0.68	0.66	0.84	0.71
36	0.43	0.30	1.66	0.76	0.2875	0.2280	1.6885	0.5706	0.59	0.48	0.81	0.74	0.63	0.66	0.54	0.70	0.78
47	0.41	0.33	1.73	0.76	0.2720	0.2514	1.6265	0.5684	0.56	0.53	0.78	0.74	0.62	0.65	0.54	0.67	0.76
60	0.38	0.31	1.62	0.77	0.2411	0.2370	1.7332	0.5736	0.50	0.50	0.84	0.74	0.61	0.64	0.50	0.67	0.79
18	0.62	0.24	1.92	0.62	0.4787	0.1594	1.4285	0.4322	0.99	0.33	0.69	0.56	0.67	0.64	0.66	0.84	0.62
94	0.35	0.38	1.57	0.66	0.2138	0.3049	1.7857	0.4652	0.44	0.64	0.86	0.60	0.65	0.64	0.54	0.65	0.73
97	0.43	0.21	1.73	0.85	0.2856	0.1343	1.6267	0.6558	0.59	0.28	0.78	0.85	0.55	0.63	0.44	0.69	0.82
24	0.44	0.25	1.78	0.78	0.3038	0.1711	1.5727	0.5845	0.63	0.36	0.76	0.76	0.58	0.63	0.49	0.69	0.76
21	0.42	0.31	1.74	0.68	0.2825	0.2335	1.6085	0.4919	0.58	0.49	0.78	0.64	0.62	0.62	0.54	0.68	0.71

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
41	0.36	0.32	1.72	0.75	0.2184	0.2443	1.6348	0.5531	0.45	0.51	0.79	0.72	0.58	0.62	0.48	0.62	0.75
1	0.26	0.30	1.69	0.91	0.1244	0.2257	1.6658	0.7185	0.26	0.47	0.80	0.93	0.51	0.62	0.36	0.53	0.87
54	0.47	0.25	1.89	0.71	0.3266	0.1773	1.4625	0.5214	0.68	0.37	0.70	0.68	0.58	0.61	0.52	0.69	0.69
84	0.44	0.26	1.89	0.75	0.2999	0.1808	1.4640	0.5564	0.62	0.38	0.71	0.72	0.57	0.61	0.50	0.66	0.71
7	0.50	0.25	1.81	0.61	0.3578	0.1760	1.5439	0.4227	0.74	0.37	0.74	0.55	0.62	0.60	0.55	0.74	0.65
65	0.37	0.27	1.82	0.77	0.2286	0.1937	1.5345	0.5810	0.47	0.40	0.74	0.75	0.54	0.59	0.44	0.61	0.75
28	0.39	0.26	1.82	0.75	0.2481	0.1803	1.5285	0.5569	0.51	0.38	0.74	0.72	0.54	0.59	0.44	0.62	0.73
100	0.28	0.37	1.56	0.64	0.1402	0.2916	1.7884	0.4443	0.29	0.61	0.86	0.58	0.59	0.58	0.45	0.58	0.72
79	0.45	0.26	1.84	0.63	0.3121	0.1816	1.5142	0.4398	0.65	0.38	0.73	0.57	0.58	0.58	0.51	0.69	0.65
3	0.28	0.21	1.84	0.93	0.1440	0.1373	1.5150	0.7363	0.30	0.29	0.73	0.95	0.44	0.57	0.29	0.51	0.84
4	0.49	0.20	1.97	0.66	0.3455	0.1217	1.3868	0.4693	0.71	0.25	0.67	0.61	0.55	0.56	0.48	0.69	0.64
66	0.31	0.27	1.79	0.74	0.1715	0.1913	1.5618	0.5496	0.35	0.40	0.75	0.71	0.50	0.55	0.38	0.55	0.73
67	0.32	0.25	1.84	0.77	0.1809	0.1757	1.5148	0.5734	0.37	0.37	0.73	0.74	0.49	0.55	0.37	0.55	0.74
98	0.28	0.26	1.78	0.78	0.1402	0.1858	1.5760	0.5837	0.29	0.39	0.76	0.76	0.48	0.55	0.34	0.52	0.76
92	0.34	0.26	1.89	0.71	0.1969	0.1813	1.4621	0.5214	0.41	0.38	0.70	0.68	0.50	0.54	0.39	0.56	0.69
12	0.39	0.22	1.95	0.72	0.2486	0.1399	1.4052	0.5256	0.51	0.29	0.68	0.68	0.49	0.54	0.40	0.60	0.68
71	0.33	0.24	1.99	0.77	0.1933	0.1627	1.3660	0.5798	0.40	0.34	0.66	0.75	0.47	0.54	0.37	0.53	0.70
27	0.35	0.25	1.92	0.70	0.2062	0.1769	1.4291	0.5120	0.43	0.37	0.69	0.66	0.49	0.54	0.40	0.56	0.68
45	0.29	0.26	1.81	0.73	0.1544	0.1806	1.5425	0.5406	0.32	0.38	0.74	0.70	0.48	0.54	0.35	0.53	0.72
68	0.36	0.25	1.97	0.70	0.2171	0.1700	1.3865	0.5102	0.45	0.36	0.67	0.66	0.49	0.53	0.40	0.56	0.66
6	0.27	0.26	1.82	0.75	0.1259	0.1825	1.5311	0.5561	0.26	0.38	0.74	0.72	0.46	0.52	0.32	0.50	0.73
33	0.33	0.23	1.89	0.71	0.1880	0.1572	1.4599	0.5156	0.39	0.33	0.70	0.67	0.47	0.52	0.36	0.55	0.69
8	0.47	0.26	1.83	0.42	0.3263	0.1832	1.5196	0.2269	0.68	0.38	0.73	0.29	0.60	0.52	0.53	0.70	0.51
90	0.46	0.20	2.17	0.65	0.3156	0.1263	1.1877	0.4580	0.65	0.26	0.57	0.59	0.50	0.52	0.46	0.61	0.58
85	0.40	0.24	1.98	0.60	0.2602	0.1652	1.3713	0.4124	0.54	0.35	0.66	0.53	0.51	0.52	0.44	0.60	0.60
99	0.27	0.21	1.97	0.82	0.1286	0.1355	1.3822	0.6320	0.27	0.28	0.67	0.82	0.41	0.51	0.27	0.47	0.74
9	0.35	0.24	1.83	0.58	0.2129	0.1654	1.5261	0.3917	0.44	0.35	0.74	0.51	0.51	0.51	0.39	0.59	0.62
86	0.35	0.25	1.98	0.61	0.2128	0.1720	1.3776	0.4167	0.44	0.36	0.66	0.54	0.49	0.50	0.40	0.55	0.60
89	0.40	0.20	2.21	0.70	0.2570	0.1189	1.1477	0.5062	0.53	0.25	0.55	0.66	0.44	0.50	0.39	0.54	0.60
29	0.36	0.21	1.98	0.62	0.2160	0.1355	1.3685	0.4322	0.45	0.28	0.66	0.56	0.46	0.49	0.37	0.55	0.61
75	0.41	0.19	2.14	0.61	0.2708	0.1157	1.2165	0.4168	0.56	0.24	0.59	0.54	0.46	0.48	0.40	0.57	0.56
16	0.36	0.18	2.11	0.65	0.2254	0.1062	1.2462	0.4559	0.47	0.22	0.60	0.59	0.43	0.47	0.34	0.53	0.60
31	0.38	0.19	2.11	0.59	0.2428	0.1182	1.2433	0.3996	0.50	0.25	0.60	0.52	0.45	0.47	0.37	0.55	0.56
19	0.43	0.17	2.09	0.52	0.2919	0.0931	1.2642	0.3302	0.60	0.19	0.61	0.43	0.47	0.46	0.40	0.61	0.52
52	0.23	0.25	1.92	0.61	0.0930	0.1772	1.4290	0.4181	0.19	0.37	0.69	0.54	0.42	0.45	0.28	0.44	0.61
56	0.34	0.22	1.99	0.51	0.1982	0.1460	1.3609	0.3136	0.41	0.31	0.66	0.41	0.46	0.44	0.36	0.53	0.53
70	0.40	0.19	2.19	0.53	0.2610	0.1142	1.1598	0.3350	0.54	0.24	0.56	0.43	0.45	0.44	0.39	0.55	0.50

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
34	0.24	0.22	1.91	0.62	0.1036	0.1414	1.4430	0.4231	0.21	0.30	0.70	0.55	0.40	0.44	0.25	0.45	0.62
43	0.22	0.21	2.10	0.72	0.0807	0.1330	1.2501	0.5323	0.17	0.28	0.60	0.69	0.35	0.43	0.22	0.38	0.65
61	0.32	0.17	2.21	0.63	0.1787	0.0948	1.1456	0.4419	0.37	0.20	0.55	0.57	0.37	0.42	0.28	0.46	0.56
76	0.48	0.17	2.37	0.43	0.3429	0.0919	0.9790	0.2347	0.71	0.19	0.47	0.30	0.46	0.42	0.45	0.59	0.39
39	0.35	0.19	2.16	0.50	0.2095	0.1129	1.1904	0.3097	0.43	0.24	0.57	0.40	0.41	0.41	0.33	0.50	0.49
35	0.20	0.19	2.11	0.70	0.0609	0.1183	1.2446	0.5110	0.13	0.25	0.60	0.66	0.32	0.41	0.19	0.36	0.63
73	0.39	0.15	2.51	0.61	0.2476	0.0714	0.8411	0.4161	0.51	0.15	0.41	0.54	0.36	0.40	0.33	0.46	0.47
14	0.24	0.16	2.34	0.76	0.0972	0.0829	1.0180	0.5682	0.20	0.17	0.49	0.74	0.29	0.40	0.19	0.35	0.61
20	0.27	0.15	2.28	0.65	0.1313	0.0784	1.0725	0.4545	0.27	0.16	0.52	0.59	0.32	0.39	0.22	0.39	0.55
59	0.30	0.21	1.98	0.39	0.1621	0.1351	1.3756	0.1985	0.34	0.28	0.66	0.26	0.43	0.38	0.31	0.50	0.46
49	0.24	0.16	2.35	0.70	0.1026	0.0878	1.0004	0.5056	0.21	0.18	0.48	0.65	0.29	0.38	0.20	0.35	0.57
42	0.35	0.20	2.09	0.36	0.2123	0.1200	1.2607	0.1688	0.44	0.25	0.61	0.22	0.43	0.38	0.35	0.52	0.41
81	0.40	0.23	2.01	0.19	0.2565	0.1502	1.3437	-	0.53	0.31	0.65	-	0.50	0.37	0.42	0.59	0.32
58	0.32	0.19	2.11	0.40	0.1842	0.1137	1.2447	0.2088	0.38	0.24	0.60	0.27	0.41	0.37	0.31	0.49	0.44
63	0.25	0.16	2.31	0.63	0.1101	0.0828	1.0481	0.4416	0.23	0.17	0.51	0.57	0.30	0.37	0.20	0.37	0.54
25	0.26	0.18	2.14	0.51	0.1217	0.1048	1.2094	0.3132	0.25	0.22	0.58	0.41	0.35	0.36	0.24	0.42	0.49
23	0.26	0.15	2.25	0.58	0.1171	0.0756	1.0994	0.3904	0.24	0.16	0.53	0.51	0.31	0.36	0.20	0.39	0.52
51	0.24	0.18	2.15	0.53	0.0969	0.1049	1.2046	0.3329	0.20	0.22	0.58	0.43	0.33	0.36	0.21	0.39	0.51
64	0.37	0.16	2.37	0.42	0.2303	0.0803	0.9830	0.2247	0.48	0.17	0.47	0.29	0.37	0.35	0.32	0.48	0.38
87	0.22	0.17	2.30	0.62	0.0782	0.0905	1.0546	0.4232	0.16	0.19	0.51	0.55	0.29	0.35	0.18	0.33	0.53
5	0.19	0.17	2.29	0.65	0.0547	0.0913	1.0595	0.4560	0.11	0.19	0.51	0.59	0.27	0.35	0.15	0.31	0.55
37	0.18	0.18	2.24	0.62	0.0391	0.1033	1.1159	0.4245	0.08	0.22	0.54	0.55	0.28	0.35	0.15	0.31	0.54
2	0.30	0.18	2.17	0.39	0.1626	0.1016	1.1879	0.1966	0.34	0.21	0.57	0.25	0.37	0.34	0.27	0.45	0.41
10	0.23	0.18	2.16	0.47	0.0935	0.1077	1.1890	0.2788	0.19	0.23	0.57	0.36	0.33	0.34	0.21	0.38	0.47
96	0.20	0.17	2.19	0.51	0.0647	0.0986	1.1642	0.3169	0.13	0.21	0.56	0.41	0.30	0.33	0.17	0.35	0.49
93	0.22	0.16	2.42	0.54	0.0808	0.0790	0.9307	0.3449	0.17	0.17	0.45	0.45	0.26	0.31	0.17	0.31	0.45
40	0.26	0.17	2.20	0.35	0.1175	0.0935	1.1548	0.1613	0.24	0.20	0.56	0.21	0.33	0.30	0.22	0.40	0.38
62	0.36	0.13	2.55	0.38	0.2223	0.0499	0.8038	0.1862	0.46	0.10	0.39	0.24	0.32	0.30	0.28	0.42	0.31
88	0.28	0.13	2.56	0.44	0.1372	0.0509	0.7958	0.2511	0.28	0.11	0.38	0.33	0.26	0.27	0.20	0.33	0.35
77	0.19	0.15	2.49	0.52	0.0480	0.0784	0.8599	0.3252	0.10	0.16	0.41	0.42	0.23	0.27	0.13	0.26	0.42
48	0.18	0.16	2.24	0.44	0.0372	0.0798	1.1100	0.2432	0.08	0.17	0.53	0.31	0.26	0.27	0.12	0.31	0.42
80	0.26	0.11	2.92	0.53	0.1184	0.0308	0.4366	0.3399	0.24	0.06	0.21	0.44	0.17	0.24	0.15	0.23	0.33
22	0.20	0.11	2.59	0.50	0.0623	0.0299	0.7662	0.3030	0.13	0.06	0.37	0.39	0.19	0.24	0.10	0.25	0.38
74	0.16	0.12	2.26	0.40	0.0238	0.0477	1.0932	0.2118	0.05	0.10	0.53	0.27	0.23	0.24	0.07	0.29	0.40
13	0.16	0.13	2.53	0.48	0.0167	0.0569	0.8214	0.2922	0.03	0.12	0.40	0.38	0.18	0.23	0.08	0.22	0.39
95	0.14	0.14	2.61	0.43	-	0.0652	0.7384	0.2358	-	0.14	0.36	0.31	0.16	0.20	0.07	0.18	0.33
17	0.25	0.09	2.95	0.41	0.1087	0.0171	0.4067	0.2152	0.22	0.04	0.20	0.28	0.15	0.18	0.13	0.21	0.24

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	Reock	Polsby-Popper	Schwartzberg	Population Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
72	0.26	0.08	3.35	0.45	0.1197	-	-	0.2553	0.25	-	-	0.33	0.08	0.14	0.12	0.12	0.17

Districts Challenged for Lack of Compactness

District with a Majority of Adult African-American Population

Sorce: United States Census Bureau, 2011 TIGER File and 2010 Redistricting Data File

TABLE 8-I

Virginia 2011 Enacted House of Delegates Redistricting Plan (HB-5005)

Data on Four Measures of Compactness

Sorted by Reock and Schwartzberg Percentiles - High to Low

	Reock	Polsby-Popper	Schwartz-berg	Popula- tion Polygon
Min	0.14	0.08	1.28	0.19
Max	0.62	0.55	3.35	0.96
Mean	0.36	0.24	2.00	0.64
Std. Dev.	0.11	0.09	0.35	0.16

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartz berg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
38	0.62	0.45	1.44	0.84	0.4834	0.3778	1.9093	0.6430	1.00	0.79	0.92	0.83	0.90	0.89	0.89	0.96	0.88
91	0.60	0.47	1.45	0.58	0.4582	0.3930	1.9052	0.3848	0.95	0.82	0.92	0.50	0.90	0.80	0.88	0.93	0.71
82	0.57	0.45	1.48	0.72	0.4312	0.3704	1.8781	0.5238	0.89	0.77	0.91	0.68	0.86	0.81	0.83	0.90	0.79
46	0.52	0.55	1.28	0.94	0.3771	0.4785	2.0752	0.7507	0.78	1.00	1.00	0.97	0.93	0.94	0.89	0.89	0.99
15	0.55	0.34	1.52	0.83	0.4072	0.2587	1.8350	0.6339	0.84	0.54	0.88	0.82	0.76	0.77	0.69	0.86	0.85
30	0.53	0.36	1.49	0.83	0.3937	0.2882	1.8639	0.6345	0.81	0.60	0.90	0.82	0.77	0.78	0.71	0.86	0.86
55	0.57	0.28	1.69	0.66	0.4291	0.2078	1.6616	0.4718	0.89	0.43	0.80	0.61	0.71	0.68	0.66	0.84	0.71
18	0.62	0.24	1.92	0.62	0.4787	0.1594	1.4285	0.4322	0.99	0.33	0.69	0.56	0.67	0.64	0.66	0.84	0.62
11	0.59	0.26	1.80	0.83	0.4483	0.1857	1.5555	0.6381	0.93	0.39	0.75	0.83	0.69	0.72	0.66	0.84	0.79
69	0.52	0.34	1.68	0.85	0.3799	0.2646	1.6749	0.6579	0.79	0.55	0.81	0.85	0.72	0.75	0.67	0.80	0.83
83	0.52	0.34	1.69	0.84	0.3769	0.2663	1.6624	0.6479	0.78	0.56	0.80	0.84	0.71	0.74	0.67	0.79	0.82
57	0.45	0.41	1.47	0.96	0.3143	0.3304	1.8815	0.7724	0.65	0.69	0.91	1.00	0.75	0.81	0.67	0.78	0.95
26	0.46	0.36	1.57	0.85	0.3182	0.2872	1.7839	0.6575	0.66	0.60	0.86	0.85	0.71	0.74	0.63	0.76	0.86
50	0.46	0.34	1.62	0.77	0.3178	0.2643	1.7371	0.5808	0.66	0.55	0.84	0.75	0.68	0.70	0.60	0.75	0.79
32	0.46	0.31	1.64	0.89	0.3196	0.2320	1.7100	0.6950	0.66	0.48	0.82	0.90	0.66	0.72	0.57	0.74	0.86
7	0.50	0.25	1.81	0.61	0.3578	0.1760	1.5439	0.4227	0.74	0.37	0.74	0.55	0.62	0.60	0.55	0.74	0.65
78	0.46	0.35	1.65	0.77	0.3198	0.2778	1.7061	0.5762	0.66	0.58	0.82	0.75	0.69	0.70	0.62	0.74	0.78
53	0.46	0.34	1.69	0.77	0.3174	0.2588	1.6609	0.5742	0.66	0.54	0.80	0.74	0.67	0.69	0.60	0.73	0.77
36	0.43	0.30	1.66	0.76	0.2875	0.2280	1.6885	0.5706	0.59	0.48	0.81	0.74	0.63	0.66	0.54	0.70	0.78
8	0.47	0.26	1.83	0.42	0.3263	0.1832	1.5196	0.2269	0.68	0.38	0.73	0.29	0.60	0.52	0.53	0.70	0.51
44	0.43	0.32	1.69	0.87	0.2915	0.2411	1.6626	0.6757	0.60	0.50	0.80	0.87	0.64	0.70	0.55	0.70	0.84
24	0.44	0.25	1.78	0.78	0.3038	0.1711	1.5727	0.5845	0.63	0.36	0.76	0.76	0.58	0.63	0.49	0.69	0.76
4	0.49	0.20	1.97	0.66	0.3455	0.1217	1.3868	0.4693	0.71	0.25	0.67	0.61	0.55	0.56	0.48	0.69	0.64
54	0.47	0.25	1.89	0.71	0.3266	0.1773	1.4625	0.5214	0.68	0.37	0.70	0.68	0.58	0.61	0.52	0.69	0.69
79	0.45	0.26	1.84	0.63	0.3121	0.1816	1.5142	0.4398	0.65	0.38	0.73	0.57	0.58	0.58	0.51	0.69	0.65

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
97	0.43	0.21	1.73	0.85	0.2856	0.1343	1.6267	0.6558	0.59	0.28	0.78	0.85	0.55	0.63	0.44	0.69	0.82
21	0.42	0.31	1.74	0.68	0.2825	0.2335	1.6085	0.4919	0.58	0.49	0.78	0.64	0.62	0.62	0.54	0.68	0.71
47	0.41	0.33	1.73	0.76	0.2720	0.2514	1.6265	0.5684	0.56	0.53	0.78	0.74	0.62	0.65	0.54	0.67	0.76
60	0.38	0.31	1.62	0.77	0.2411	0.2370	1.7332	0.5736	0.50	0.50	0.84	0.74	0.61	0.64	0.50	0.67	0.79
84	0.44	0.26	1.89	0.75	0.2999	0.1808	1.4640	0.5564	0.62	0.38	0.71	0.72	0.57	0.61	0.50	0.66	0.71
94	0.35	0.38	1.57	0.66	0.2138	0.3049	1.7857	0.4652	0.44	0.64	0.86	0.60	0.65	0.64	0.54	0.65	0.73
28	0.39	0.26	1.82	0.75	0.2481	0.1803	1.5285	0.5569	0.51	0.38	0.74	0.72	0.54	0.59	0.44	0.62	0.73
41	0.36	0.32	1.72	0.75	0.2184	0.2443	1.6348	0.5531	0.45	0.51	0.79	0.72	0.58	0.62	0.48	0.62	0.75
90	0.46	0.20	2.17	0.65	0.3156	0.1263	1.1877	0.4580	0.65	0.26	0.57	0.59	0.50	0.52	0.46	0.61	0.58
19	0.43	0.17	2.09	0.52	0.2919	0.0931	1.2642	0.3302	0.60	0.19	0.61	0.43	0.47	0.46	0.40	0.61	0.52
65	0.37	0.27	1.82	0.77	0.2286	0.1937	1.5345	0.5810	0.47	0.40	0.74	0.75	0.54	0.59	0.44	0.61	0.75
85	0.40	0.24	1.98	0.60	0.2602	0.1652	1.3713	0.4124	0.54	0.35	0.66	0.53	0.51	0.52	0.44	0.60	0.60
12	0.39	0.22	1.95	0.72	0.2486	0.1399	1.4052	0.5256	0.51	0.29	0.68	0.68	0.49	0.54	0.40	0.60	0.68
76	0.48	0.17	2.37	0.43	0.3429	0.0919	0.9790	0.2347	0.71	0.19	0.47	0.30	0.46	0.42	0.45	0.59	0.39
81	0.40	0.23	2.01	0.19	0.2565	0.1502	1.3437	-	0.53	0.31	0.65	-	0.50	0.37	0.42	0.59	0.32
9	0.35	0.24	1.83	0.58	0.2129	0.1654	1.5261	0.3917	0.44	0.35	0.74	0.51	0.51	0.51	0.39	0.59	0.62
100	0.28	0.37	1.56	0.64	0.1402	0.2916	1.7884	0.4443	0.29	0.61	0.86	0.58	0.59	0.58	0.45	0.58	0.72
75	0.41	0.19	2.14	0.61	0.2708	0.1157	1.2165	0.4168	0.56	0.24	0.59	0.54	0.46	0.48	0.40	0.57	0.56
68	0.36	0.25	1.97	0.70	0.2171	0.1700	1.3865	0.5102	0.45	0.36	0.67	0.66	0.49	0.53	0.40	0.56	0.66
27	0.35	0.25	1.92	0.70	0.2062	0.1769	1.4291	0.5120	0.43	0.37	0.69	0.66	0.49	0.54	0.40	0.56	0.68
92	0.34	0.26	1.89	0.71	0.1969	0.1813	1.4621	0.5214	0.41	0.38	0.70	0.68	0.50	0.54	0.39	0.56	0.69
66	0.31	0.27	1.79	0.74	0.1715	0.1913	1.5618	0.5496	0.35	0.40	0.75	0.71	0.50	0.55	0.38	0.55	0.73
29	0.36	0.21	1.98	0.62	0.2160	0.1355	1.3685	0.4322	0.45	0.28	0.66	0.56	0.46	0.49	0.37	0.55	0.61
67	0.32	0.25	1.84	0.77	0.1809	0.1757	1.5148	0.5734	0.37	0.37	0.73	0.74	0.49	0.55	0.37	0.55	0.74
86	0.35	0.25	1.98	0.61	0.2128	0.1720	1.3776	0.4167	0.44	0.36	0.66	0.54	0.49	0.50	0.40	0.55	0.60
31	0.38	0.19	2.11	0.59	0.2428	0.1182	1.2433	0.3996	0.50	0.25	0.60	0.52	0.45	0.47	0.37	0.55	0.56
70	0.40	0.19	2.19	0.53	0.2610	0.1142	1.1598	0.3350	0.54	0.24	0.56	0.43	0.45	0.44	0.39	0.55	0.50
33	0.33	0.23	1.89	0.71	0.1880	0.1572	1.4599	0.5156	0.39	0.33	0.70	0.67	0.47	0.52	0.36	0.55	0.69
89	0.40	0.20	2.21	0.70	0.2570	0.1189	1.1477	0.5062	0.53	0.25	0.55	0.66	0.44	0.50	0.39	0.54	0.60
16	0.36	0.18	2.11	0.65	0.2254	0.1062	1.2462	0.4559	0.47	0.22	0.60	0.59	0.43	0.47	0.34	0.53	0.60
56	0.34	0.22	1.99	0.51	0.1982	0.1460	1.3609	0.3136	0.41	0.31	0.66	0.41	0.46	0.44	0.36	0.53	0.53
45	0.29	0.26	1.81	0.73	0.1544	0.1806	1.5425	0.5406	0.32	0.38	0.74	0.70	0.48	0.54	0.35	0.53	0.72
1	0.26	0.30	1.69	0.91	0.1244	0.2257	1.6658	0.7185	0.26	0.47	0.80	0.93	0.51	0.62	0.36	0.53	0.87
71	0.33	0.24	1.99	0.77	0.1933	0.1627	1.3660	0.5798	0.40	0.34	0.66	0.75	0.47	0.54	0.37	0.53	0.70
98	0.28	0.26	1.78	0.78	0.1402	0.1858	1.5760	0.5837	0.29	0.39	0.76	0.76	0.48	0.55	0.34	0.52	0.76
42	0.35	0.20	2.09	0.36	0.2123	0.1200	1.2607	0.1688	0.44	0.25	0.61	0.22	0.43	0.38	0.35	0.52	0.41
3	0.28	0.21	1.84	0.93	0.1440	0.1373	1.5150	0.7363	0.30	0.29	0.73	0.95	0.44	0.57	0.29	0.51	0.84

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
39	0.35	0.19	2.16	0.50	0.2095	0.1129	1.1904	0.3097	0.43	0.24	0.57	0.40	0.41	0.41	0.33	0.50	0.49
59	0.30	0.21	1.98	0.39	0.1621	0.1351	1.3756	0.1985	0.34	0.28	0.66	0.26	0.43	0.38	0.31	0.50	0.46
6	0.27	0.26	1.82	0.75	0.1259	0.1825	1.5311	0.5561	0.26	0.38	0.74	0.72	0.46	0.52	0.32	0.50	0.73
58	0.32	0.19	2.11	0.40	0.1842	0.1137	1.2447	0.2088	0.38	0.24	0.60	0.27	0.41	0.37	0.31	0.49	0.44
64	0.37	0.16	2.37	0.42	0.2303	0.0803	0.9830	0.2247	0.48	0.17	0.47	0.29	0.37	0.35	0.32	0.48	0.38
99	0.27	0.21	1.97	0.82	0.1286	0.1355	1.3822	0.6320	0.27	0.28	0.67	0.82	0.41	0.51	0.27	0.47	0.74
61	0.32	0.17	2.21	0.63	0.1787	0.0948	1.1456	0.4419	0.37	0.20	0.55	0.57	0.37	0.42	0.28	0.46	0.56
73	0.39	0.15	2.51	0.61	0.2476	0.0714	0.8411	0.4161	0.51	0.15	0.41	0.54	0.36	0.40	0.33	0.46	0.47
34	0.24	0.22	1.91	0.62	0.1036	0.1414	1.4430	0.4231	0.21	0.30	0.70	0.55	0.40	0.44	0.25	0.45	0.62
2	0.30	0.18	2.17	0.39	0.1626	0.1016	1.1879	0.1966	0.34	0.21	0.57	0.25	0.37	0.34	0.27	0.45	0.41
52	0.23	0.25	1.92	0.61	0.0930	0.1772	1.4290	0.4181	0.19	0.37	0.69	0.54	0.42	0.45	0.28	0.44	0.61
62	0.36	0.13	2.55	0.38	0.2223	0.0499	0.8038	0.1862	0.46	0.10	0.39	0.24	0.32	0.30	0.28	0.42	0.31
25	0.26	0.18	2.14	0.51	0.1217	0.1048	1.2094	0.3132	0.25	0.22	0.58	0.41	0.35	0.36	0.24	0.42	0.49
40	0.26	0.17	2.20	0.35	0.1175	0.0935	1.1548	0.1613	0.24	0.20	0.56	0.21	0.33	0.30	0.22	0.40	0.38
20	0.27	0.15	2.28	0.65	0.1313	0.0784	1.0725	0.4545	0.27	0.16	0.52	0.59	0.32	0.39	0.22	0.39	0.55
51	0.24	0.18	2.15	0.53	0.0969	0.1049	1.2046	0.3329	0.20	0.22	0.58	0.43	0.33	0.36	0.21	0.39	0.51
23	0.26	0.15	2.25	0.58	0.1171	0.0756	1.0994	0.3904	0.24	0.16	0.53	0.51	0.31	0.36	0.20	0.39	0.52
43	0.22	0.21	2.10	0.72	0.0807	0.1330	1.2501	0.5323	0.17	0.28	0.60	0.69	0.35	0.43	0.22	0.38	0.65
10	0.23	0.18	2.16	0.47	0.0935	0.1077	1.1890	0.2788	0.19	0.23	0.57	0.36	0.33	0.34	0.21	0.38	0.47
63	0.25	0.16	2.31	0.63	0.1101	0.0828	1.0481	0.4416	0.23	0.17	0.51	0.57	0.30	0.37	0.20	0.37	0.54
35	0.20	0.19	2.11	0.70	0.0609	0.1183	1.2446	0.5110	0.13	0.25	0.60	0.66	0.32	0.41	0.19	0.36	0.63
96	0.20	0.17	2.19	0.51	0.0647	0.0986	1.1642	0.3169	0.13	0.21	0.56	0.41	0.30	0.33	0.17	0.35	0.49
49	0.24	0.16	2.35	0.70	0.1026	0.0878	1.0004	0.5056	0.21	0.18	0.48	0.65	0.29	0.38	0.20	0.35	0.57
14	0.24	0.16	2.34	0.76	0.0972	0.0829	1.0180	0.5682	0.20	0.17	0.49	0.74	0.29	0.40	0.19	0.35	0.61
87	0.22	0.17	2.30	0.62	0.0782	0.0905	1.0546	0.4232	0.16	0.19	0.51	0.55	0.29	0.35	0.18	0.33	0.53
88	0.28	0.13	2.56	0.44	0.1372	0.0509	0.7958	0.2511	0.28	0.11	0.38	0.33	0.26	0.27	0.20	0.33	0.35
5	0.19	0.17	2.29	0.65	0.0547	0.0913	1.0595	0.4560	0.11	0.19	0.51	0.59	0.27	0.35	0.15	0.31	0.55
37	0.18	0.18	2.24	0.62	0.0391	0.1033	1.1159	0.4245	0.08	0.22	0.54	0.55	0.28	0.35	0.15	0.31	0.54
93	0.22	0.16	2.42	0.54	0.0808	0.0790	0.9307	0.3449	0.17	0.17	0.45	0.45	0.26	0.31	0.17	0.31	0.45
48	0.18	0.16	2.24	0.44	0.0372	0.0798	1.1100	0.2432	0.08	0.17	0.53	0.31	0.26	0.27	0.12	0.31	0.42
74	0.16	0.12	2.26	0.40	0.0238	0.0477	1.0932	0.2118	0.05	0.10	0.53	0.27	0.23	0.24	0.07	0.29	0.40
77	0.19	0.15	2.49	0.52	0.0480	0.0784	0.8599	0.3252	0.10	0.16	0.41	0.42	0.23	0.27	0.13	0.26	0.42
22	0.20	0.11	2.59	0.50	0.0623	0.0299	0.7662	0.3030	0.13	0.06	0.37	0.39	0.19	0.24	0.10	0.25	0.38
80	0.26	0.11	2.92	0.53	0.1184	0.0308	0.4366	0.3399	0.24	0.06	0.21	0.44	0.17	0.24	0.15	0.23	0.33
13	0.16	0.13	2.53	0.48	0.0167	0.0569	0.8214	0.2922	0.03	0.12	0.40	0.38	0.18	0.23	0.08	0.22	0.39
17	0.25	0.09	2.95	0.41	0.1087	0.0171	0.4067	0.2152	0.22	0.04	0.20	0.28	0.15	0.18	0.13	0.21	0.24
95	0.14	0.14	2.61	0.43	-	0.0652	0.7384	0.2358	-	0.14	0.36	0.31	0.16	0.20	0.07	0.18	0.33

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
72	0.26	0.08	3.35	0.45	0.1197	-	-	0.2553	0.25	-	-	0.33	0.08	0.14	0.12	0.12	0.17

Districts Challenged for Lack of Compactness

District with a Majority of Adult African-American Population

Sorce: United States Census Bureau, 2011 TIGER File and 2010 Redistricting Data File

TABLE 8-J

Virginia 2011 Enacted House of Delegates Redistricting Plan (HB-5005)

Data on Four Measures of Compactness

Sorted by All Four Test Percentiles - High to Low

	Reock	Polsby-Popper	Schwartz-berg	Popula- tion Polygon
Min	0.14	0.08	1.28	0.19
Max	0.62	0.55	3.35	0.96
Mean	0.36	0.24	2.00	0.64
Std. Dev.	0.11	0.09	0.35	0.16

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartz berg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartz berg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
46	0.52	0.55	1.28	0.94	0.3771	0.4785	2.0752	0.7507	0.78	1.00	1.00	0.97	0.93	0.94	0.89	0.89	0.99
38	0.62	0.45	1.44	0.84	0.4834	0.3778	1.9093	0.6430	1.00	0.79	0.92	0.83	0.90	0.89	0.89	0.96	0.88
82	0.57	0.45	1.48	0.72	0.4312	0.3704	1.8781	0.5238	0.89	0.77	0.91	0.68	0.86	0.81	0.83	0.90	0.79
57	0.45	0.41	1.47	0.96	0.3143	0.3304	1.8815	0.7724	0.65	0.69	0.91	1.00	0.75	0.81	0.67	0.78	0.95
91	0.60	0.47	1.45	0.58	0.4582	0.3930	1.9052	0.3848	0.95	0.82	0.92	0.50	0.90	0.80	0.88	0.93	0.71
30	0.53	0.36	1.49	0.83	0.3937	0.2882	1.8639	0.6345	0.81	0.60	0.90	0.82	0.77	0.78	0.71	0.86	0.86
15	0.55	0.34	1.52	0.83	0.4072	0.2587	1.8350	0.6339	0.84	0.54	0.88	0.82	0.76	0.77	0.69	0.86	0.85
69	0.52	0.34	1.68	0.85	0.3799	0.2646	1.6749	0.6579	0.79	0.55	0.81	0.85	0.72	0.75	0.67	0.80	0.83
83	0.52	0.34	1.69	0.84	0.3769	0.2663	1.6624	0.6479	0.78	0.56	0.80	0.84	0.71	0.74	0.67	0.79	0.82
26	0.46	0.36	1.57	0.85	0.3182	0.2872	1.7839	0.6575	0.66	0.60	0.86	0.85	0.71	0.74	0.63	0.76	0.86
11	0.59	0.26	1.80	0.83	0.4483	0.1857	1.5555	0.6381	0.93	0.39	0.75	0.83	0.69	0.72	0.66	0.84	0.79
32	0.46	0.31	1.64	0.89	0.3196	0.2320	1.7100	0.6950	0.66	0.48	0.82	0.90	0.66	0.72	0.57	0.74	0.86
78	0.46	0.35	1.65	0.77	0.3198	0.2778	1.7061	0.5762	0.66	0.58	0.82	0.75	0.69	0.70	0.62	0.74	0.78
50	0.46	0.34	1.62	0.77	0.3178	0.2643	1.7371	0.5808	0.66	0.55	0.84	0.75	0.68	0.70	0.60	0.75	0.79
44	0.43	0.32	1.69	0.87	0.2915	0.2411	1.6626	0.6757	0.60	0.50	0.80	0.87	0.64	0.70	0.55	0.70	0.84
53	0.46	0.34	1.69	0.77	0.3174	0.2588	1.6609	0.5742	0.66	0.54	0.80	0.74	0.67	0.69	0.60	0.73	0.77
55	0.57	0.28	1.69	0.66	0.4291	0.2078	1.6616	0.4718	0.89	0.43	0.80	0.61	0.71	0.68	0.66	0.84	0.71
36	0.43	0.30	1.66	0.76	0.2875	0.2280	1.6885	0.5706	0.59	0.48	0.81	0.74	0.63	0.66	0.54	0.70	0.78
47	0.41	0.33	1.73	0.76	0.2720	0.2514	1.6265	0.5684	0.56	0.53	0.78	0.74	0.62	0.65	0.54	0.67	0.76
60	0.38	0.31	1.62	0.77	0.2411	0.2370	1.7332	0.5736	0.50	0.50	0.84	0.74	0.61	0.64	0.50	0.67	0.79
18	0.62	0.24	1.92	0.62	0.4787	0.1594	1.4285	0.4322	0.99	0.33	0.69	0.56	0.67	0.64	0.66	0.84	0.62
94	0.35	0.38	1.57	0.66	0.2138	0.3049	1.7857	0.4652	0.44	0.64	0.86	0.60	0.65	0.64	0.54	0.65	0.73
97	0.43	0.21	1.73	0.85	0.2856	0.1343	1.6267	0.6558	0.59	0.28	0.78	0.85	0.55	0.63	0.44	0.69	0.82
24	0.44	0.25	1.78	0.78	0.3038	0.1711	1.5727	0.5845	0.63	0.36	0.76	0.76	0.58	0.63	0.49	0.69	0.76
21	0.42	0.31	1.74	0.68	0.2825	0.2335	1.6085	0.4919	0.58	0.49	0.78	0.64	0.62	0.62	0.54	0.68	0.71

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
41	0.36	0.32	1.72	0.75	0.2184	0.2443	1.6348	0.5531	0.45	0.51	0.79	0.72	0.58	0.62	0.48	0.62	0.75
1	0.26	0.30	1.69	0.91	0.1244	0.2257	1.6658	0.7185	0.26	0.47	0.80	0.93	0.51	0.62	0.36	0.53	0.87
54	0.47	0.25	1.89	0.71	0.3266	0.1773	1.4625	0.5214	0.68	0.37	0.70	0.68	0.58	0.61	0.52	0.69	0.69
84	0.44	0.26	1.89	0.75	0.2999	0.1808	1.4640	0.5564	0.62	0.38	0.71	0.72	0.57	0.61	0.50	0.66	0.71
7	0.50	0.25	1.81	0.61	0.3578	0.1760	1.5439	0.4227	0.74	0.37	0.74	0.55	0.62	0.60	0.55	0.74	0.65
65	0.37	0.27	1.82	0.77	0.2286	0.1937	1.5345	0.5810	0.47	0.40	0.74	0.75	0.54	0.59	0.44	0.61	0.75
28	0.39	0.26	1.82	0.75	0.2481	0.1803	1.5285	0.5569	0.51	0.38	0.74	0.72	0.54	0.59	0.44	0.62	0.73
100	0.28	0.37	1.56	0.64	0.1402	0.2916	1.7884	0.4443	0.29	0.61	0.86	0.58	0.59	0.58	0.45	0.58	0.72
79	0.45	0.26	1.84	0.63	0.3121	0.1816	1.5142	0.4398	0.65	0.38	0.73	0.57	0.58	0.58	0.51	0.69	0.65
3	0.28	0.21	1.84	0.93	0.1440	0.1373	1.5150	0.7363	0.30	0.29	0.73	0.95	0.44	0.57	0.29	0.51	0.84
4	0.49	0.20	1.97	0.66	0.3455	0.1217	1.3868	0.4693	0.71	0.25	0.67	0.61	0.55	0.56	0.48	0.69	0.64
66	0.31	0.27	1.79	0.74	0.1715	0.1913	1.5618	0.5496	0.35	0.40	0.75	0.71	0.50	0.55	0.38	0.55	0.73
67	0.32	0.25	1.84	0.77	0.1809	0.1757	1.5148	0.5734	0.37	0.37	0.73	0.74	0.49	0.55	0.37	0.55	0.74
98	0.28	0.26	1.78	0.78	0.1402	0.1858	1.5760	0.5837	0.29	0.39	0.76	0.76	0.48	0.55	0.34	0.52	0.76
92	0.34	0.26	1.89	0.71	0.1969	0.1813	1.4621	0.5214	0.41	0.38	0.70	0.68	0.50	0.54	0.39	0.56	0.69
12	0.39	0.22	1.95	0.72	0.2486	0.1399	1.4052	0.5256	0.51	0.29	0.68	0.68	0.49	0.54	0.40	0.60	0.68
71	0.33	0.24	1.99	0.77	0.1933	0.1627	1.3660	0.5798	0.40	0.34	0.66	0.75	0.47	0.54	0.37	0.53	0.70
27	0.35	0.25	1.92	0.70	0.2062	0.1769	1.4291	0.5120	0.43	0.37	0.69	0.66	0.49	0.54	0.40	0.56	0.68
45	0.29	0.26	1.81	0.73	0.1544	0.1806	1.5425	0.5406	0.32	0.38	0.74	0.70	0.48	0.54	0.35	0.53	0.72
68	0.36	0.25	1.97	0.70	0.2171	0.1700	1.3865	0.5102	0.45	0.36	0.67	0.66	0.49	0.53	0.40	0.56	0.66
6	0.27	0.26	1.82	0.75	0.1259	0.1825	1.5311	0.5561	0.26	0.38	0.74	0.72	0.46	0.52	0.32	0.50	0.73
33	0.33	0.23	1.89	0.71	0.1880	0.1572	1.4599	0.5156	0.39	0.33	0.70	0.67	0.47	0.52	0.36	0.55	0.69
8	0.47	0.26	1.83	0.42	0.3263	0.1832	1.5196	0.2269	0.68	0.38	0.73	0.29	0.60	0.52	0.53	0.70	0.51
90	0.46	0.20	2.17	0.65	0.3156	0.1263	1.1877	0.4580	0.65	0.26	0.57	0.59	0.50	0.52	0.46	0.61	0.58
85	0.40	0.24	1.98	0.60	0.2602	0.1652	1.3713	0.4124	0.54	0.35	0.66	0.53	0.51	0.52	0.44	0.60	0.60
99	0.27	0.21	1.97	0.82	0.1286	0.1355	1.3822	0.6320	0.27	0.28	0.67	0.82	0.41	0.51	0.27	0.47	0.74
9	0.35	0.24	1.83	0.58	0.2129	0.1654	1.5261	0.3917	0.44	0.35	0.74	0.51	0.51	0.51	0.39	0.59	0.62
86	0.35	0.25	1.98	0.61	0.2128	0.1720	1.3776	0.4167	0.44	0.36	0.66	0.54	0.49	0.50	0.40	0.55	0.60
89	0.40	0.20	2.21	0.70	0.2570	0.1189	1.1477	0.5062	0.53	0.25	0.55	0.66	0.44	0.50	0.39	0.54	0.60
29	0.36	0.21	1.98	0.62	0.2160	0.1355	1.3685	0.4322	0.45	0.28	0.66	0.56	0.46	0.49	0.37	0.55	0.61
75	0.41	0.19	2.14	0.61	0.2708	0.1157	1.2165	0.4168	0.56	0.24	0.59	0.54	0.46	0.48	0.40	0.57	0.56
16	0.36	0.18	2.11	0.65	0.2254	0.1062	1.2462	0.4559	0.47	0.22	0.60	0.59	0.43	0.47	0.34	0.53	0.60
31	0.38	0.19	2.11	0.59	0.2428	0.1182	1.2433	0.3996	0.50	0.25	0.60	0.52	0.45	0.47	0.37	0.55	0.56
19	0.43	0.17	2.09	0.52	0.2919	0.0931	1.2642	0.3302	0.60	0.19	0.61	0.43	0.47	0.46	0.40	0.61	0.52
52	0.23	0.25	1.92	0.61	0.0930	0.1772	1.4290	0.4181	0.19	0.37	0.69	0.54	0.42	0.45	0.28	0.44	0.61
56	0.34	0.22	1.99	0.51	0.1982	0.1460	1.3609	0.3136	0.41	0.31	0.66	0.41	0.46	0.44	0.36	0.53	0.53
70	0.40	0.19	2.19	0.53	0.2610	0.1142	1.1598	0.3350	0.54	0.24	0.56	0.43	0.45	0.44	0.39	0.55	0.50

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
34	0.24	0.22	1.91	0.62	0.1036	0.1414	1.4430	0.4231	0.21	0.30	0.70	0.55	0.40	0.44	0.25	0.45	0.62
43	0.22	0.21	2.10	0.72	0.0807	0.1330	1.2501	0.5323	0.17	0.28	0.60	0.69	0.35	0.43	0.22	0.38	0.65
61	0.32	0.17	2.21	0.63	0.1787	0.0948	1.1456	0.4419	0.37	0.20	0.55	0.57	0.37	0.42	0.28	0.46	0.56
76	0.48	0.17	2.37	0.43	0.3429	0.0919	0.9790	0.2347	0.71	0.19	0.47	0.30	0.46	0.42	0.45	0.59	0.39
39	0.35	0.19	2.16	0.50	0.2095	0.1129	1.1904	0.3097	0.43	0.24	0.57	0.40	0.41	0.41	0.33	0.50	0.49
35	0.20	0.19	2.11	0.70	0.0609	0.1183	1.2446	0.5110	0.13	0.25	0.60	0.66	0.32	0.41	0.19	0.36	0.63
73	0.39	0.15	2.51	0.61	0.2476	0.0714	0.8411	0.4161	0.51	0.15	0.41	0.54	0.36	0.40	0.33	0.46	0.47
14	0.24	0.16	2.34	0.76	0.0972	0.0829	1.0180	0.5682	0.20	0.17	0.49	0.74	0.29	0.40	0.19	0.35	0.61
20	0.27	0.15	2.28	0.65	0.1313	0.0784	1.0725	0.4545	0.27	0.16	0.52	0.59	0.32	0.39	0.22	0.39	0.55
59	0.30	0.21	1.98	0.39	0.1621	0.1351	1.3756	0.1985	0.34	0.28	0.66	0.26	0.43	0.38	0.31	0.50	0.46
49	0.24	0.16	2.35	0.70	0.1026	0.0878	1.0004	0.5056	0.21	0.18	0.48	0.65	0.29	0.38	0.20	0.35	0.57
42	0.35	0.20	2.09	0.36	0.2123	0.1200	1.2607	0.1688	0.44	0.25	0.61	0.22	0.43	0.38	0.35	0.52	0.41
81	0.40	0.23	2.01	0.19	0.2565	0.1502	1.3437	-	0.53	0.31	0.65	-	0.50	0.37	0.42	0.59	0.32
58	0.32	0.19	2.11	0.40	0.1842	0.1137	1.2447	0.2088	0.38	0.24	0.60	0.27	0.41	0.37	0.31	0.49	0.44
63	0.25	0.16	2.31	0.63	0.1101	0.0828	1.0481	0.4416	0.23	0.17	0.51	0.57	0.30	0.37	0.20	0.37	0.54
25	0.26	0.18	2.14	0.51	0.1217	0.1048	1.2094	0.3132	0.25	0.22	0.58	0.41	0.35	0.36	0.24	0.42	0.49
23	0.26	0.15	2.25	0.58	0.1171	0.0756	1.0994	0.3904	0.24	0.16	0.53	0.51	0.31	0.36	0.20	0.39	0.52
51	0.24	0.18	2.15	0.53	0.0969	0.1049	1.2046	0.3329	0.20	0.22	0.58	0.43	0.33	0.36	0.21	0.39	0.51
64	0.37	0.16	2.37	0.42	0.2303	0.0803	0.9830	0.2247	0.48	0.17	0.47	0.29	0.37	0.35	0.32	0.48	0.38
87	0.22	0.17	2.30	0.62	0.0782	0.0905	1.0546	0.4232	0.16	0.19	0.51	0.55	0.29	0.35	0.18	0.33	0.53
5	0.19	0.17	2.29	0.65	0.0547	0.0913	1.0595	0.4560	0.11	0.19	0.51	0.59	0.27	0.35	0.15	0.31	0.55
37	0.18	0.18	2.24	0.62	0.0391	0.1033	1.1159	0.4245	0.08	0.22	0.54	0.55	0.28	0.35	0.15	0.31	0.54
2	0.30	0.18	2.17	0.39	0.1626	0.1016	1.1879	0.1966	0.34	0.21	0.57	0.25	0.37	0.34	0.27	0.45	0.41
10	0.23	0.18	2.16	0.47	0.0935	0.1077	1.1890	0.2788	0.19	0.23	0.57	0.36	0.33	0.34	0.21	0.38	0.47
96	0.20	0.17	2.19	0.51	0.0647	0.0986	1.1642	0.3169	0.13	0.21	0.56	0.41	0.30	0.33	0.17	0.35	0.49
93	0.22	0.16	2.42	0.54	0.0808	0.0790	0.9307	0.3449	0.17	0.17	0.45	0.45	0.26	0.31	0.17	0.31	0.45
40	0.26	0.17	2.20	0.35	0.1175	0.0935	1.1548	0.1613	0.24	0.20	0.56	0.21	0.33	0.30	0.22	0.40	0.38
62	0.36	0.13	2.55	0.38	0.2223	0.0499	0.8038	0.1862	0.46	0.10	0.39	0.24	0.32	0.30	0.28	0.42	0.31
88	0.28	0.13	2.56	0.44	0.1372	0.0509	0.7958	0.2511	0.28	0.11	0.38	0.33	0.26	0.27	0.20	0.33	0.35
77	0.19	0.15	2.49	0.52	0.0480	0.0784	0.8599	0.3252	0.10	0.16	0.41	0.42	0.23	0.27	0.13	0.26	0.42
48	0.18	0.16	2.24	0.44	0.0372	0.0798	1.1100	0.2432	0.08	0.17	0.53	0.31	0.26	0.27	0.12	0.31	0.42
80	0.26	0.11	2.92	0.53	0.1184	0.0308	0.4366	0.3399	0.24	0.06	0.21	0.44	0.17	0.24	0.15	0.23	0.33
22	0.20	0.11	2.59	0.50	0.0623	0.0299	0.7662	0.3030	0.13	0.06	0.37	0.39	0.19	0.24	0.10	0.25	0.38
74	0.16	0.12	2.26	0.40	0.0238	0.0477	1.0932	0.2118	0.05	0.10	0.53	0.27	0.23	0.24	0.07	0.29	0.40
13	0.16	0.13	2.53	0.48	0.0167	0.0569	0.8214	0.2922	0.03	0.12	0.40	0.38	0.18	0.23	0.08	0.22	0.39
95	0.14	0.14	2.61	0.43	-	0.0652	0.7384	0.2358	-	0.14	0.36	0.31	0.16	0.20	0.07	0.18	0.33
17	0.25	0.09	2.95	0.41	0.1087	0.0171	0.4067	0.2152	0.22	0.04	0.20	0.28	0.15	0.18	0.13	0.21	0.24

District	Compactness Score				Distance From Lowest Score				Percentile Scores (in Decimals)								
	Reock	Polsby-Popper	Schwartzberg	Popula-tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	Reock	Polsby-Popper	Schwartzberg	Popula- tion Polygon	3 Score Avg.	4 Score Avg.	Reock * Polsby Avg.	Schwartz + Reock Avg.	Pop-Poly + Schwartz
72	0.26	0.08	3.35	0.45	0.1197	-	-	0.2553	0.25	-	-	0.33	0.08	0.14	0.12	0.12	0.17

Districts Challenged for Lack of Compactness

District with a Majority of Adult African-American Population

Sorce: United States Census Bureau, 2011 TIGER File and 2010 Redistricting Data File

TABLE 9

HB-5005 Compactness Test Score Percentiles

Districts with Percentile Scores Less than Hightest Scoring of Plaintiffs' 5 Districts

Exhibit	Sorting Order	District in White Classification With Scores Below the Most Compact District Named in Plaintiffs' Complaint (Colored White on Exhibits)	Number of Districts in White Classification
8-A	District Number	Not Applicable	0
8-B	Reock Score	1, 5, 6, 10, 14, 17, 20, 23, 25, 34, 35, 37, 40, 43, 49, 51, 52, 87, 93, 96, 99	21
8-C	Polsby-Popper Score	17, 20, 23, 62, 64, 73, 93	7
8-D	Schwartzberg Score	3, 14, 17, 20, 23, 49, 62, 64, 73, 76, 87, 93	12
8-E	Population-Polygon Score	2, 8, 10, 17, 40, 42, 58, 59, 62, 64, 76. 81	12
8-F	Combined Reock and Polsby-Popper Scores	5, 14, 17, 23, 35, 37, 49, 87, 93, 96	9
8-G	Population-Polygon and Schwartzberg Scores	2, 17, 40, 42, 62, 64, 76, 81	8
8-H	Reock, Polsby-Popper and Schwartzberg Scores	17	1
8-I	Reock and Schwartzberg Scores	5, 17, 37, 97	4
8-J	All Four Scores	17	1

TABLE 10

Compactness Scores for Reock & Polsby-Popper Tests
For Legislative Districts Challenged in *Jamerson* and *Wilkins* Cases
VA Challenged Districts from 1991, 2001 and 2011 Plans

Plan	Court Case	District Number	Reock Dispersion	Polsby-Popper Perimeter
1991 Senate Plan	Jamerson	15	0.23	0.10
1991 Senate Plan	Jamerson	18	0.12	0.10
2001 Senate Plan	Wilkins	1	0.42	0.23
2001 Senate Plan	Wilkins	2	0.45	0.29
2001 Senate Plan	Wilkins	3	0.28	0.18
2001 Senate Plan	Wilkins	4	0.31	0.25
2001 Senate Plan	Wilkins	5	0.35	0.15
2001 Senate Plan	Wilkins	9	0.24	0.16
2001 Senate Plan	Wilkins	13	0.42	0.20
2001 Senate Plan	Wilkins	16	0.36	0.17
2001 Senate Plan	Wilkins	18	0.22	0.12
2001 House Plan	Wilkins	49	0.25	0.18
2001 House Plan	Wilkins	62	0.34	0.15
2001 House Plan	Wilkins	64	0.42	0.19
2001 House Plan	Wilkins	69	0.37	0.20
2001 House Plan	Wilkins	70	0.47	0.14
2001 House Plan	Wilkins	71	0.24	0.19
2001 House Plan	Wilkins	74	0.16	0.10
2001 House Plan	Wilkins	77	0.25	0.24
2001 House Plan	Wilkins	79	0.37	0.24
2001 House Plan	Wilkins	80	0.39	0.26
2001 House Plan	Wilkins	83	0.31	0.38
2001 House Plan	Wilkins	89	0.58	0.31
2001 House Plan	Wilkins	90	0.35	0.22
2001 House Plan	Wilkins	91	0.57	0.40
2001 House Plan	Wilkins	92	0.25	0.14
2001 House Plan	Wilkins	95	0.43	0.29
2001 House Plan	Wilkins	100	0.27	0.35
2011 House Plan	Vesilind	13	0.16	0.13
2011 House Plan	Vesilind	22	0.20	0.11
2011 House Plan	Vesilind	48	0.18	0.16
2011 House Plan	Vesilind	72	0.26	0.08
2011 House Plan	Vesilind	88	0.28	0.13

Source:

All data for 1991 and 2001 (Enrolled Plans) from 2001 Dr. Gerald Webster Report - Tables 1 (House Districts) & Table 5 (Senate Districts)

All data for 2011 plans from Maptitude Standard Reports

Appendix 1

RESUME

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Qualifications:

A varied career in government, business, academia and politics. Positions of significant responsibility, requiring intelligence, scholarship, communications skills, creativity and leadership include

- Successful completion of a Doctorate in Government requiring research and writing skills and the ability to communicate in an academic setting. Also includes a firm grounding in the philosophical and political roots of the American Governmental System.
- Litigation support and courtroom experience as a qualified expert witness in federal court. Clear presentation of difficult demographic and statistical concepts – making them understandable to non-technical audiences.
- Strategic and tactical analysis of political and demographic data for campaigns and political organizations. Understanding of survey design and interpretation, political resource targeting, list development and use of direct mail.
- Experience in management and information systems – including database construction, geographic information systems and creation of user interfaces that allow access by persons without extensive computer skills.
- Senior executive management of an office within a large government agency, planning and directing operations of a staff with a diverse number of missions while coordinating activities ranging across an entire agency.
- Setting up a new U. S. House subcommittee and conducting oversight, developing legislation and interacting with leadership. Experience in statistical, demographic and budgetary analysis.
- Creating and managing small businesses, including budgeting, human resources, facilities management, accounting and shareholder interface.

Areas of Expertise:

- **Redistricting**: Over 50 years of experience in the redistricting field. Development of computerized redistricting systems. Analysis of census and political data used for redistricting. Drafting of plans for congressional, legislative and local districts in multiple states. Submission of numerous expert reports and trial testimony as an expert witness.
- **Operations:** Recruiting, training and directing staffs for existing and newly instituted projects in government and national political organizations. Private sector experience as a business owner and CAO. Proven ability to organize and direct multiple projects with

effective use of delegation. Able to function as a team player in both management and support positions.

- **Communications:** Ability to develop and deliver engaging and informative presentations involving difficult concepts and issues to decision-makers, the public and press. Effective in preparation of affidavits and exhibits as well as giving depositions and delivering courtroom testimony.
- **Information Technology:** Expertise in analysis of complex technical problems involving large amounts of data – both for analysis and practical use in business, government and politics. Able to break down information and develop effective solutions. Ability to interface between highly technical personnel and management.
- **GIS:** Considerable experience in integration of mapping and data (geographic information systems).
- **Budget & Programs:** Experience in budget formulation and managing accurate accounting systems in the private and public sectors.

Education:

- **Claremont Graduate University**, Claremont, CA – Ph.D. in Government - 1980
- **Claremont McKenna College**, Claremont CA – B. A. in Political Science - 1970
- **U. S. Navy, Electronics School,** Treasure Island, CA, Graduate -1966

Publications:

- Thomas S. Engeman, Edward J. Erler and Thomas B. Hofeller (1980. **The Federalist Concordance.** Chicago: University of Chicago Press.
- Grofman, Bernard and Hofeller, Thomas B (1990). **"Comparing the Compactness of California Congressional districts Under Three Different Plans".** In Bernard Grofman (ed) *Political Gerrymandering and the Courts.* New York: Agathon.
- Richard Niemi, Bernard Grofman, Thomas Hofeller, and Carl Carlucci (1990). **Measuring the Compactness and the Role of a Compactness Standard in a Test for Partisan Gerrymanderings". *Journal of Politics.***
- **Reports and affidavits prepared for, and testimony in, numerous court cases** (listed below).

References:

Current and recent employer references are available and will be furnished upon request.

Experience:

Geographic Strategies LLC **Partner** **May 2011 – present**
7119 Marine Drive
Alexandria, Virginia 22307

- Geographic Strategies provides redistricting services clients including database construction, strategic political and legal planning in preparation for actual line drawing, support services and training on the use of geographic information systems (GIS) used in redistricting, analysis of plan drafts, and actual line-drawing when requested. The corporation and its principals also provide litigation support.

State Government Leadership Foundation **Redistricting Consultant** **April 2011 – April 2012**
1800 Diagonal Road, Suite 230

Alexandria, VA 22314 **Contracting Officer:** J. Christopher Jankowski
Executive Director
(571-480-4861

- Retained as a consultant to state legislatures and statewide elected officials in all aspects of their work on the 2011-2012 redistricting process.

Areas of consultation:

- Develop strategic and tactical plans for Legislatures and statewide elected officials to develop and defend redistricting plans for legislative and congressional districts.
- Providing assistance in actual redistricting plan drafting and analysis.
- Providing a linkage between complex legal standards and their practical application to plan drafting in difficult political and technical environments.
- Provide assistance in redistricting litigation
- Identification of specialized GIS software, database and hardware systems to be used by stakeholders.
- Ongoing strategic, technical and legal support to those involved in redistricting in all states.
- Development of a clearinghouse of redistricting activities throughout the nation and analysis of the effects of the process on future elections.

REPUBLICAN NATIONAL COMMITTEE
310 First Street, S.E.
Washington, DC 20003

Redistricting Consultant

May 2009 – April 2011

Contracting Officer: John Phillippe
RNC Chief Counsel
(202) 863-8638

- Retained as a consultant to recreate a new department to coordinate the redistricting activities of the National Committee and the greater GOP community in preparation and execution of the 2011 redistricting Areas of responsibility and to support the Committee's 2011 through 2012 redistricting efforts:
  - Developed a strategic plan for the Committee to best position itself for maximum success in this highly competitive process.
  - Liaison and training with members of Congress, legislators, key statewide officials, state parties and other divisions within the Committee to ensure a high level of political, technical and legal preparation.
  - Recruitment and training of a technical and legal staff.
  - Providing a linkage between complex legal standards and their practical application to plan drafting in difficult political and technical environments
  - Identification of specialized GIS software, database and hardware systems to be used by the Committee and other stakeholders.
  - Ongoing strategic, technical and legal support to members of congress and those involved in redistricting in all states, including plan drafting.
  - Development of a clearinghouse of redistricting activities throughout the nation and analysis of the effects of the process on future elections.

DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY
1400 Independence Avenue
Washington, DC 20250

Associate Administrator for Operations and Management

June 2004 – January 2009

Supervisor: Teresa C Lasseter, Administrator
Farm Service Agency
(229) 890-9127

- Associate Administrator providing management and oversight to staff with diverse missions supporting the activities of the entire Farm Service Agency (FSA).

Areas of responsibility:

- Provides oversight and guidance to the 1,100 person staff of the Deputy Administrator for Management. These functions include management services, human resources, financial management, budgeting, and information technology.

- Directs the activities of the Office of Civil Rights which performs all of the EEO functions for the Agency, as well managing FSA's diversity programs.
- Provides oversight and guidance to the Office of Business and Program Integration. This office supports a wide range of cross-cutting activities including economic policy analysis, strategic planning, outreach, state and county office review, county service center integration, emergency planning, county office reviews and audits, e-Government, and program appeals and litigation.
- Has primary oversight of the business realignment process underway in the Agency. This realignment includes such projects as Agency-wide enterprise architecture development, field office realignment, and concurrent changes to the Agency's business processes. This realignment is necessary to allow the Agency to meet the present and future challenges involved in providing the best possible customers service and implementation the President's Management Agenda.
- Spearheads the ongoing reform of the FSA county committee election system which included the drafting of guidelines just published in the Federal Register.

DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY
1400 Independence Avenue
Washington, DC 20250

Director, Office of Business and Program Integration

Apr. 2003 – June 2004

Supervisor: Verle Lanier, Associate Administrator for Operations and Management (retired)
(301) 424-5776

- ❑ Director of a senior level office directing the activities of subordinate staffs with diverse missions supporting the overall activities of the Farm Service Agency.

Areas of responsibility:

- Provided oversight and guidance to the 75-person staff of the Office of Business and Program Integration. This office supported a wide range of cross-cutting activities including economic policy analysis, strategic planning, outreach, state and county office review, county service center integration, emergency planning, county office reviews and audits, e-Government, and program appeals and litigation.
- Directed the development of administrative strategies essential to the successful management of e-Government initiatives. Coordinated citizen-centered eGovernment initiatives.
- Provided centralized direction for the Agency's strategic plan in compliance with the Government Performance and Results Act of 1993.
- Coordinated outreach efforts for all FSA programs to enhance participation of small or limited resource farmers and ranchers to provide equal access to programs striving to acquire and maintain economic viability for family farmers and ranchers.

- Directed the preparation of policies and dockets on national program determinations to be submitted for CCC Board consideration and Federal Register publications.

REPUBLICAN NATIONAL COMMITTEE **Redistricting Director** **Jul. '99 – Mar. 2003**
310 First Street, S.E.

Washington, DC 20003 Supervisor: Thomas Josefiak, former RNC Chief Counsel
(703) 647-2940

- Hired to create a new department to coordinate the redistricting activities of the National Committee mandated by the release of data from the 2000 Decennial Census.

(See the description of present position.)

U. S. HOUSE SUBCOMMITTEE ON THE CENSUS **Staff Director** **Feb. '98 - Jul. '99**

Supervisor: Hon. Dan Miller, Chairman
(202) 225-5015

- Staff Director at inception of this oversight subcommittee, created by the House in February of 1998, to monitor the preparations for and the execution of the 2000 Decennial Census. Directed all day-to day operations of the subcommittee including:
  - Recruitment and training of a staff for a new subcommittee.
  - Liaison with the Director and Senior Staff of the Census Bureau, the Department of Commerce, and U.S. Senate Staff involved in census oversight.
  - A complete examination of the preparations underway at the Census Bureau for conduct of the 2000 Decennial Census.
  - An examination of the proposed statistical methods proposed by the Bureau to improve coverage of the Census.
  - Reviewed and made recommendations to the Chairman and House Leadership regarding census policy.
  - Coordination with Government Accounting Office personnel involved in census oversight.
  - Preparation and support for oversight hearings conducted by the members of the Subcommittee.
  - Interface between the academic statistical community and the subcommittee in the development of census policy.
  - Liaison with census stakeholders in general, with particular attention to members of the Decennial Census Advisory Committees.

U. S. HOUSE COMMITTEE ON HOUSE OVERSIGHT **Professional Staff** **Nov. '97 - Feb. '98**

Supervisor: Hon. William M. Thomas, Chairman
(202) 225-2915

- Involved in the oversight activities of the Committee that supervises the operations of the U.S. House of Representatives. Advised the Chairman and House Leadership on congressional policy with regard to all census operations prior to the establishment of the Subcommittee on the Census

PARTES CORPORATION **Director of Administration** **Mar. '96 - Nov. '97**

Kirkland, Washington

Supervisor: Mark Schnitzer, Chairman

- Chief Administrator of a software development company specializing in the creation of databases used by investment professionals to analyze information on securities.

Information was downloaded, parsed, and reformatted from the Securities and Exchange Commission's EDGAR database and other relevant sources. Was responsible for all administrative functions of the corporation including:

- Procurement, renovation and management of facilities housing the company.
- All human resource activities.
- Accounting and payroll.
- Liaison with attorneys and shareholders.

CAMPAIGN MAIL & DATA, INC **Professional Staff** **Nov. '93 - Mar. '96**

Falls Church, Virginia

Supervisor: John Simms, President
(703) 790-8676

- Supervised development and maintenance of geographic databases that were integrated with the company's various political and commercial lists. Created a new department that collected and converted voter lists from states, counties and towns.

NATIONAL REPUBLICAN CONGRESSIONAL COMMITTEE **Redistricting Director** **Mar. '89 – Nov. '93**

320 First Street, S.E.
Washington, DC 20003

Supervisor: Maria Cino, Chief of Staff

- Created a new department to coordinate the redistricting activities of the NRCC and provide support to all GOP members of the U.S. House and their staffs.

Areas of responsibility:

- Recruitment and training of a technical staff.

- Development of specialized GIS software, databases and hardware systems to be used by the Committee and members of Congress.

REPUBLICAN NATIONAL COMMITTEE — **MIS Director** — **Jan. '82 – Mar. 89**
310 First Street, S.E.
Washington, DC 20003

- Transformed the Committee's computer capabilities from a single mainframe system operated completely within a computer division into a building-wide network, utilized by all divisions and from remote locations. Supervised all the Committee's data processing activities, including database and software development. Directed research activities involving analyses of demographic and election data. Primary computer consultant to the GOP's state and county party organizations.

ROSE INSTITUTE OF STATE AND LOCAL GOVERNMENT — **Associate Director** — **1973 – 1981**
Claremont McKenna College
Claremont, California

- Co-Founder of this Southern California research center specializing in the examination of current financial and political issues affecting California's state and local governments. Supervised staff and day-to-day operations, directed software and database development, managed research projects and assisted in fundraising.

COMPASS SYSTEMS, INC. AND LOCAL GOVERNMENT — **Vice President** — **1970 – 1973**
San Diego, California

- Part of the management team that developed the first computerized geographic mapping and data retrieval system used by the California State Assembly for redistricting and demographic analysis. Directly supervised programming and database development staffs.

UNITED STATES NAVY — **Petty Officer 2nd Class** — **1965 – 1969**

- Electronics Technician. Served on USS Porterfield, DD682, in Tonkin Gulf operations during Vietnam War. (Honorable Discharge)

Summary of Participation in Lawsuits:

Shaw v. Hunt, 92-202-CIV-5-BR, U.S. District Court for the Eastern District of North Carolina, Raleigh Division (1993-4)

This case was the second trial phase following the U.S. Supreme Court's reversal of the lower court in Shaw v. Reno (1993). Prepared alternative plans for presentation to the court. Prepared political and demographic analyses of the state's plans, along with numerous exhibits supporting the plaintiffs' complaints. Gave a deposition and served as plaintiffs' primary expert witness at trial.

Arizonans for Fair Representation v. Symington, CIV 92-0256, U.S. District Court Arizona (1992), aff'd mem. sub nom. Arizona Community Forum v. Symington, 506 U.S. 969 (1992)

Prepared an affidavit evaluating the three major plans submitted to court for redistricting of Arizona's six congressional districts. Plans were examined with regard to all major redistricting criteria. Also examined minority voting strength in proposed new sixth district in State Senate Plan. Gave expert testimony in trial phase. Drafted a new map for presentation in court that was adopted, with minor changes, by the three-judge panel.

De Grandy v. Wetherell, No 92-40015-WS, U.S. District Court Florida (1992)

Prepared model plans and submitted affidavits evaluating alternative plans for two of the parties in the congressional phase of the case and gave testimony on the political and voting rights implications of various other plans. Presented an affidavit and gave expert testimony in the legislative phase of the case for the De Grandy plaintiffs.

Good v. Van Straten, 800 F. Supp. 557, U.S. District Court Eastern & Western Michigan (1992)

Prepared compactness analysis of plans submitted to court to redistrict Michigan's congressional districts. Gave testimony on compactness theories and other relevant redistricting criteria.

Pope v. Blue, U.S. District Court Western District of North Carolina (1992)

Prepared an affidavit containing compactness analysis and political analysis of the plan passed by North Carolina Legislature and approved by U.S. Department of Justice.

Ketchum v. Byrne, 740 F,2d 1398, cert. denied City Council of Chicago v. Ketchum, 471 U.S. 1135 (1985), on remand, Ketchum v. City of Chicago 630 F. Supp. 551 (N.D. Ill. 1985)

Consultant to African-American plaintiffs (P.A.C.I.). Assisted in building Plaintiffs' political and demographic database, performed a racial and ethnic analysis of City of Chicago, gave a deposition, and testified in court. Participated in second remedy phase of case, gave a second deposition, was prepared to give testimony (the case was settled before retrial).

Carrillo v. City of Los Angeles, No. CV-85-7739 JMI-JRX (unreported) (C.D. Cal. 1986)

Consultant to Mexican American Legal Defense Fund (MALDEF). Constructed database, performed analysis of ethnic voter registration levels, analyzed various plans submitted by all parties, submitted affidavit to the court.

McNeil v. Springfield School District, 656 F. Supp. 1200, 66 F. Supp. 1208 (C.D. Ill 1987), 851 F.2d, 937 (7th Cir. 1988)

Consultant to counsel for Springfield School Board. Constructed demographic database, performed analyses on various proposed districts, gave deposition, presented affidavit to court. Prepared an analysis determining levels of African-American voting strength in proposed districts.

State of Mississippi v. United States, 490 F. Supp. 569 (D.C.D.C. 1979)

Principle consultant to Joint Reapportionment Committee of Mississippi State Legislature. Compiled databases, drew plans, prepared analysis for the legislature, and gave general redistricting advice to Committee Chairman and Counsel. Gave an extensive deposition and testified before the District Court in DC. Assisted in the preparation of all briefs.

Badham v. Eu, 568 F. Supp. 156; 721 F.2d 1170 (1983); -- F.Supp. -- (Apr. 21 1988), appeal docketed, No. 87-1818 56 U.S.L.W. 3791 (U.S. May 4 1988)

Principle technical consultant to counsel for Badham Plaintiffs and Republican National Committee. In charge of all database construction, development of sample court plans, analyses of Burton Plans and preparation of maps, charts and other materials for trial. Submitted affidavits.

Bandemer v. Davis, 478 U.S. 109 (1986)

Consultant to counsel for amicus, Republican National Committee. Prepared a demonstration plan for brief submitted to U.S. Supreme Court.

California Legislature v. Reinecke, 6 Cal. 3d595 99 Cal. Rptr. 481, 492 P.2d 385 (1972)

As consultant, drafted redistricting plan for California State Senate and Assembly that were subsequently accepted by California Redistricting Commission.

Jordan v. Winter, 541 F. Supp. 1135 (N.D. Miss. 1982)

Performed analyses and gave court testimony on behalf of the defendants.

Gingles v. Edmisten, 590 F. Supp. 345 (N.D.N.C. 1984), aff'd in part and rev'd in part Thornburg v. Gingles 478 U.S. 30 (1986)

Consultant to Attorney General. Performed demographic analysis of state with regard to creation of African-American districts for North Carolina General Assembly. Gave deposition and testified in court on behalf of Legislature.

City of Port Arthur v. United States, 459 U.S. 159 (1982)

Consultant to City Attorney. Performed analysis of racial content of City Council Districts. This was required for the case required because the 1980 Decennial Census data were not yet available. Analysis required extensive residential survey to determine racial characteristics of individual districts. Gave a deposition in the case.

Ryan v. Otto, 661 F.2d 1130 (7th Cir. 1981)

Consultant to Republican plaintiffs and Illinois Congressional Delegation. Drew alternative plans for presentation to Court, gave deposition and testimony.

Rybicki v. State Board of Elections, 584 F. Supp. 849 (N.D. Ill. 1984)

Principle technical consultant to State House of Representatives and the Senate Minority Caucus. Supervised construction of all political and demographic databases. Responsible for design and programming of House's computerized redistricting information system. Analyzed and drafted numerous redistricting plans. Gave depositions and testified at trial.

La Comb v. Growe, 541 F. Supp. 145 (D.Minn.), aff'd sub nom. Orwall v. La Comb, 456 U.S. 966 (1982)

Consultant to Minority members of Congressional Delegation. Drafted a plan for presentation to Court and submitted an affidavit.

Karcher v. Daggett, 462 U.S. 725 (1983), 467 U.S. 1222 (1984)

Participated in presentation of briefs on Republican side. Consultant to members of New Jersey Congressional Delegation.

Flanagan v. Gillmor, 561 F. Supp. 36 (S.D.Ohio 1982) Brown v. Brandon, (unreported), (S.D.Ohio Jan. 30, 1984), as modified (Feb. 13, 1984), aff'd 467 U.S. 1223 (1985)

Consultant to State Legislature. Modified 1981congressional district redistricting plan to conform to "one person, one vote" standard imposed by decision of the Court.

Massachusetts Republican State Committee v. Connolly, 679 F. Supp. 109 (D. Mass. 1988)

Consultant to counsel for plaintiffs. Examined evidence submitted in regard to 1985 Massachusetts State Census (particularly for Boston), analyzed legislative redistricting plan, submitted affidavit, gave deposition.

Sinkfield v. Bennett, Civil Action CV 93-689-PR (Circuit Court of Montgomery County, Alabama)

Gave testimony supporting the replacement of the Alabama congressional plan drawn by the Federal Court with a plan drawn by the Circuit Court.

Mississippi State Conference of the NAACP v. Haley Barbour, Civil Action No. 3:11-ev-159 TSL-EGJ-LG (SD Mississippi, Jackson Division – 2011)

Prepared a declaration for the intervenors analyzing the compactness and deviations of various legislative plans submitted to the Court for consideration.

Dickson v. Rucho, Civil Action 11 CVS 16896 and North Carolina State Conference of the NAACP v. State of North Carolina, Civil Action 11CVS 16940 (General Court of Justice, Superior Court Division, Raleigh, North Carolina – 2011)

Submitted two affidavits and gave a deposition concerning my role as a consultant to the General Assembly with regard to the redistricting of North Carolina State Senate and State House of Repre-

sentative districts as well as the redistricting of that state's congressional districts. Testified at hearing before 3-judge panel.

Boone v. Nassau County Legislature, Civil Action CV 11-cv 02712 (Supreme Court of the State of New York, County of Nassau - 2011)

Prepared an affidavit evaluating the 2011 redistricting plan enacted by the Nassau County Legislature and other sample plans presented by the Plaintiffs, with particular attention to the efficacy of the use of the U.S. Census Bureau's American Community Survey for measuring compliance with the provisions of Section 2 of the Federal Voting Rights Act.

Petteway v. Henry, Civil Action CV 11-411 (SD Texas, Galveston Div. 2011)

Prepared and presented at trial an alternative redistricting plan Galveston County's commissioner districts to the court for defendant intervenors.

Pearson v. Koster, Civil Action 11AC-CC00624 (Circuit Court of Cole County, Missouri, Div. II - 2012)

Prepared an affidavit evaluating the compactness of Missouri's newly enacted congressional districts (2011) in light of the State Supreme Court's remand of this case for determination of whether or not, in light of Plaintiffs' alleged claims to the contrary, the districts reflected in H.B. 193 were sufficiently compact to meet the requirement contained in the Missouri Constitution that districts be "composed of territory as compact as may be." Served as the expert witness at trial for the defendant intervenors.

Bob Johnson v. State of Missouri, Civil Action 12AC-00056 (Circuit Court of Cole County, Missouri 2012)

Prepared an affidavit analyzing the compactness and deviations of the enacted State House of Representative districts.

Harris v. Arizona Independent Redistricting Commission, Civil Action cv-12-0894-PHX-ROS (United States District Court, District of Arizona 2012)
Prepared affidavits analyzing the state legislative districts enacted by the Arizona Independent Redistricting Commission concerning population deviations, ethnic and racial characteristics and adherence to other neutral redistricting criteria. Presented expert testimony at trial.

Cynthia Hauser v. Martin O'Malley, Civil Action September Term 2012, Misc. No 5 – 2012, (Maryland Court of Appeals)

Prepared a declaration analyzing the State Senate and State House of Maryland enacted by the Governor following the 2010 Census and comparing both plans to senate and house plans submitted by plaintiffs.. Conclusions were made concerning the integrity of county lines, and district deviations as well as adherence to the provisions of the federal Voting Rights Act.

Kermit L. Moore, Jr. v. State of Tennessee, In the Chancery Court Case No. 120402-III (2012)

Prepared an affidavit analyzing the State Senate redistricting plan enacted by the Legislature for the 2012 elections and compared it to a plan submitted as a bill by the opposition. Conclusions were made analyzing the compliance of both plans with the federal and state provisions of one-person/one vote.

David Harris v. Patrick McCrory, Civil Action No. 1:13 CV-00949 (United States District Court, Middle District of North Carolina Durham Division 2013)

Retained by Defendant's counsel to prepare a declaration in response to plaintiffs' expert report' concerning the congressional redistricting plan enacted by the North Carolina General Assembly in 2011. Gave a deposition concerning the construction and characteristics of the congressional district contained in the enacted plan as well as other relevant congressional maps.

Terry Petteway v. Galveston County, Texas, Civil No. 3:-cv-00308, (United States District Court, Southern district of Texas, Galveston Division 2013)

Retained by Defendant's counsel to prepare a redistricting map for Galveston County's Justice of the Peace Precincts, prepared a declaration in response to plaintiffs' experts' reports and gave testimony at trial.

North Carolina State Conference of the NAACP v. Patrick Lloyd McCrory, 1:13 CV-658 (United States District Court, Middle District of North Carolina 2013)

Retained by Defendant's counsel to prepare an expert report summarizing a study of information from the voter files of North Carolina's State Board of elections as compared to the North Carolina Department of Motor Vehicles' (DMV) customer file as well as locations of DMV offices proximity to potential registered voters who do not appear to have drivers licenses or DMV ID,s Performed and analyses of demographics and registration information with regard to this information. Analyzed the locations and hours of one-stop voting centers. Testified as a witness at the trial of the case.

Golden Bethune-Hill v. Virginia State Board of Elections, Civil Action No. 3:14-cv-00852 (United States Court for the Eastern District of Virginia – Richmond Division 2015)
Retained by Defendant Intervenors to prepare an expert report determining whether H.B. 5005, which the Virginia General Assembly enacted to redistrict the Virginia House of Delegates, was compact and contiguous, and also to comment on other factors which are relevant to such a determination. Offered testimony at the trial in July of 2015.

Sandra Little Covington v State of North Carolina, Civil Action No. 1:15-cv-00399 (United States District Court for the Middle District of North Carolina – 2015)

Retained by Defendant Intervenors to prepare an expert report explaining the relationship between exemplar districts identifying compact areas of minority voting strength and the actual 2011 enacted redistricting plans for both chambers of the North Carolina General Assembly. Testified at trial

APPENDIX 2

Measures of Compactness Reports

Maptitude for Redistricting computes seven measures of compactness: Reock, Schwartzberg, Perimeter, Polsby-Popper, Length-Width, Population Polygon, Population Circle, and Ehrenburg.

Plan Name: Current Congress1
Plan Type: Congressional
Date: 2/10/2010
Time: 2:15:25PM
Administrator: Howard
User: J. Smith

Measures of Compactness

2/10/2010

DISTRICT	Reock	Schwartzberg	Perimeter
1	0.26	2.54	141.04
2	0.49	1.56	237.96
3	0.57	1.58	1,424.02
4	0.40	1.59	1,163.12
5	0.44	2.25	562.98
6	0.33	2.65	206.04
Sum	N/A	N/A	3,735.16
Min	0.26	1.56	N/A
Max	0.57	2.65	N/A
Mean	0.42	2.03	N/A
Std. Dev.	0.11	0.51	N/A

The following references were used to develop these measures:

Cox, E. P. A method of assigning numerical and percentage values to the degree of roundness of sand grains. *Journal of paleontology*, 1:179-183, 1927.

Hofeller, T., and B. Grofman. Comparing the compactness of California congressional districts under three different plans: 1980, 1982 and 1984. In B. Grofmann, editor, *Toward Fair and Effective Representation*, pages 281-288, New York, 1990. Agathon.

Niemi, R. G., B. Grofman, C. Carlucci, and T. Hofeller. Measuring compactness and the role of a compactness standard in a test for partisan and racial gerrymandering. *Journal of Politics*, 52(4):1155-1181, 1990.

Polsby, D. D., and R. D. Popper. The third criterion: compactness as a procedural safeguard against partisan gerrymandering. *Yale Law and Policy Review*, 9:301-353, 1991.

Reock, E. C., Jr. Measuring the compactness as a requirement of legislative apportionment. *Midwest Journal of Political Science*, 5:70-74, 1961.

Schwartzberg, J. E. Reapportionment, gerrymanders, and the notion of compactness. *Minnesota Law Review*, 50:443-452, 1966.

Young , H. P. Measuring the compactness of legislative districts. *Legislative Studies Quarterly*, 13(1):105-115, 1988.

Ehrenburg 1892, see Frolov, Y. S., Measuring the shape of geographic phenomena: a history of the issue, Soviet Geography 16, 676-87, 1995.

Iowa State Legislature Web Site:
HTTP://WWW.LEGIS.STATE.IA.US/REDIST/JUNE2001REPORT.HTM.

Reock Test

The Reock test is an area-based measure that compares each district to a circle, which is considered to be the most compact shape possible. For each district, the Reock test computes the ratio of the area of the district to the area of the minimum enclosing circle for the district. The measure is always between 0 and 1, with 1 being the most compact. The Reock test computes one number for each district and the minimum, maximum, mean and standard deviation for the plan.

See [Reock 1961] and [Young 1988].

Schwartzberg Test

The Schwartzberg test is a perimeter-based measure that compares a simplified version of each district to a circle, which is considered to be the most compact shape possible. This test requires the base layer that was used to create the districts. The base layer is used to simplify the district to exclude complicated coastlines.

For each district, the Schwartzberg test computes the ratio of the perimeter of the simplified version of the district to the perimeter of a circle with the same area as the original district. The district is simplified by only keeping those shape points where three or more areas in the base layer come together. Water features and a neighboring state also count as base layer areas. This measure is usually greater than or equal to 1, with 1 being the most compact. Unfortunately, the simplification procedure can result in a polygon that is substantially smaller that the original district, which can yield a ratio less than 1 (e.g., an island has a 0 ratio). The Schwartzberg test computes one number for each district and the minimum, maximum, mean and standard deviation for the plan.

See [Schwartzberg 1966] and [Young 1988].

Perimeter Test

The Perimeter test computes the sum of the perimeters of all the districts. The Perimeter test computes one number for the whole plan. If you are comparing several plans, the plan with the smallest total perimeter is the most compact.

See [Young 1988].

Polsby-Popper Test

The Polsby-Popper test computes the ratio of the district area to the area of a circle with the same perimeter: $4\pi\text{Area}/(\text{Perimeter}^2)$. The measure is always between 0 and 1, with 1 being the most compact. The Polsby-Popper test computes one number for each district and the minimum, maximum, mean and standard deviation for the plan.

See [Cox 1929], [Polsby and Popper 1991], and [Niemi, Grofman, Carlucci, and Hofeller 1990].

Length-Width Test

The length-width test computes the absolute difference between the width (east-west) and the height (north-south) of each district. The bounding box of a district is computed in longitude-latitude space, and the height and width of the box through the center point are compared. The total is divided by the number of districts to create the average length-width compactness. A lower number indicates better length-width compactness. This measure of compactness is designed for contiguous districts, since the bounding box encloses the entire district.

See HTTP://WWW.LEGIS.STATE.IA.US/REDIST/JUNE2001REPORT.HTM.

Population Polygon Test

The population polygon test computes the ratio of the district population to the approximate population of the convex hull of the district (minimum convex polygon which completely contains the district). The population of the convex hull is approximated by overlaying it with a base layer, such as Census Blocks. The measure is always between 0 and 1, with 1 being the most compact. The Population Polygon test computes one number for each district and the minimum, maximum, mean and standard deviation for the plan.

See [Hofeller and Grofman 1990] and [Niemi, Grofman, Carlucci, and Hofeller 1990].

Population Circle Test

The population circle test computes the ratio of the district population to the approximate population of the minimum enclosing circle of the district. The population of the circle is approximated by overlaying it with a base layer, such as Census Blocks. The measure is always between 0 and 1, with 1 being the most compact. The Population Circle test computes one number for each district and the minimum, maximum, mean and standard deviation for the plan.

See [Hofeller and Grofman 1990] and [Niemi, Grofman, Carlucci, and Hofeller 1990].

Ehrenburg Test

The Ehrenburg test computes the ratio of the largest inscribed circle divided by the area of the district. The measure is always between 0 and 1, with 1 being the most compact. The Ehrenburg test computes one number for each district and the minimum, maximum, mean and standard deviation for the plan.

See [Frolov 1975].

APPENDIX 3

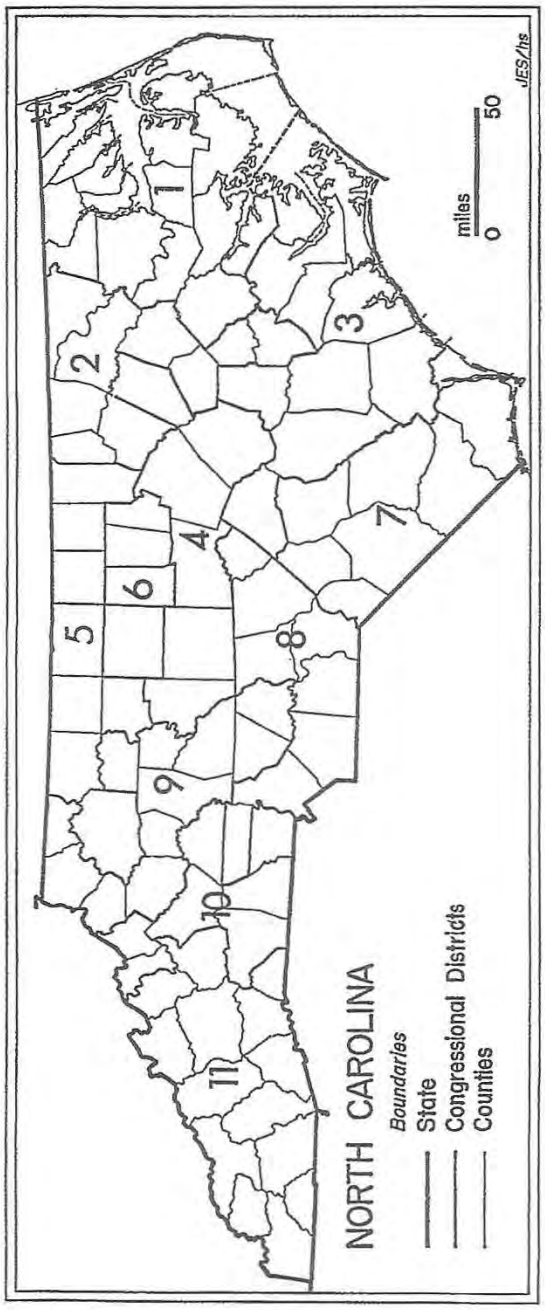

Fig. 1

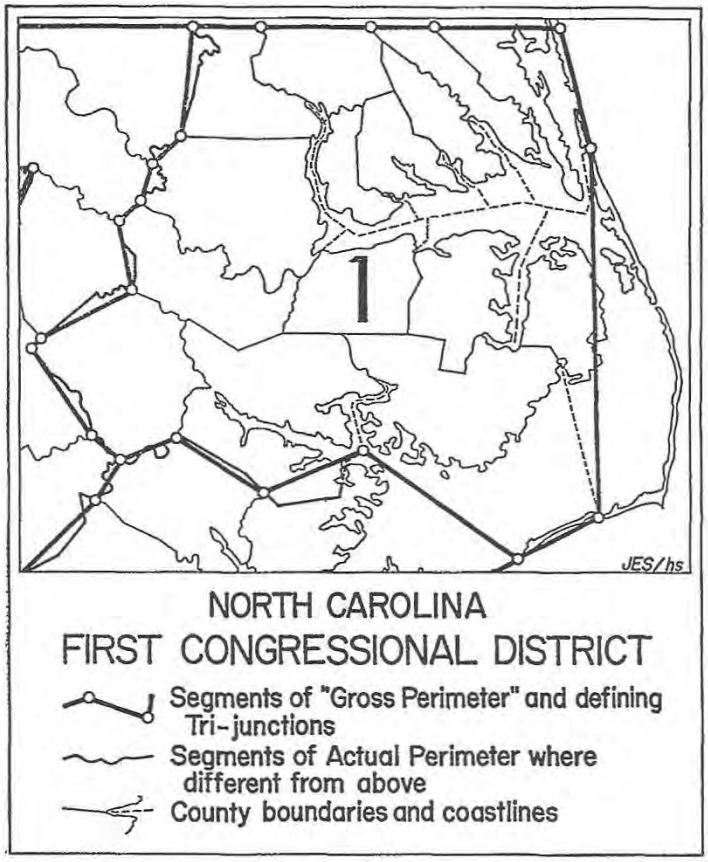
1
JES/hs
NORTH CAROLINA
FIRST CONGRESSIONAL DISTRICT
Segments of "Gross Perimeter" and defining Tri-junctions
Segments of Actual Perimeter where different from above
County boundaries and coastlines

Fig. 2

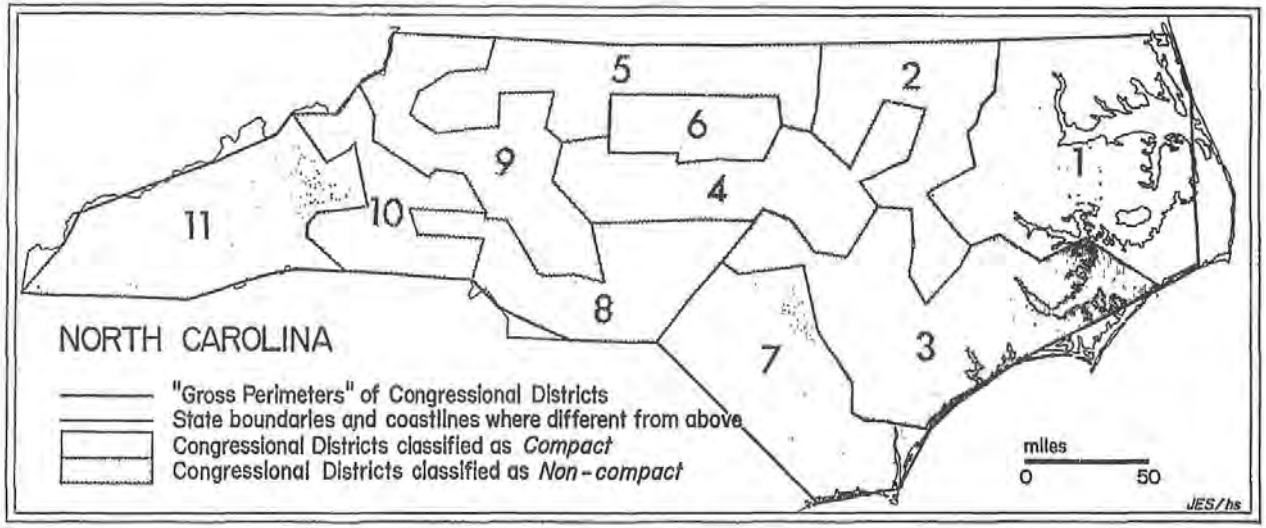
NORTH CAROLINA
"Gross Perimeters" of Congressional Districts
State boundaries and coastlines where different from above
Congressional Districts classified as Compact
Congressional Districts classified as Non-compact
miles
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Fig. 3

APPENDIX 4

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF VIRGINIA
(RICHMOND DIVISION)

GOLDEN BETHUNE-HILL, *et al.*, Plaintiffs, v. VIRGINIA STATE BOARD OF ELECTIONS, *et al.*, Defendants.	Civil Action No. 3:14-cv-00852-REP-GBL-BMK

DECLARATION OF THOMAS BROOKS HOFELLER, Ph.D.

1. I am a recognized expert in the fields of districting and reapportionment in the United States. I have been retained, as an independent consultant, through counsel by Intervenor-Defendants House Speaker William Howell and the Virginia House of Delegates to provide expert testimony in this case. My hourly rate is $300 per hour.

OBJECTIVES OF DECLARATION

2. I have been asked to determine whether H.B. 5005, the legislation enacted in 2011 by the Virginia General Assembly to redistrict Virginia's House of Delegates following the 2010 U.S. Census, is compact and contiguous.

3. Based on my review of the map and data reflecting H.B. 5005, as well as data and maps from other states, and my experience in drafting and evaluating districting plans for compactness all across the nation for five decennial redistricting cycles, it is my opinion that the 2011 Virginia House of Delegates Plan H.B. 5005 is compact and compares

favorably in terms its level of compactness to other Virginia legislative plans and plans from other states.

4. Based on my review of the geography of HB 5005, I have also determined that there are no contiguity issues with regard to the 2011 House of Delegates Plan.

QUALIFICATIONS

5. I set forth here a summary of my experience that is most relevant to this testimony. The full range of my professional qualifications and experience is included in my resume, which is attached as Exhibit 1.

6. I am a Partner in Geographic Strategies, LLC, located in Columbia, South Carolina. Geographic Strategies provides redistricting services including database construction, strategic political and legal planning in preparation for actual line drawing, support services and training on the use of geographic information systems (GIS) used in redistricting, analysis of plan drafts, and actual line-drawing when requested. The corporation and its principals also provide litigation support.

7. I hold a Ph.D. from Claremont Graduate University, where my major fields of study were American political philosophy, urban studies and American politics. I hold a B.A. from Claremont McKenna College with a major in political science.

8. I have been involved in the redistricting process for over 46 years, and have played a major role in the development of computerized redistricting systems, having first supervised the construction of such a system for the California State Assembly in 1970-71.

9. I have been active in the redistricting process leading up to and following each decennial census since 1970. I have been intimately involved with the construction of

databases combining demographic data received from the United States Census Bureau with election information which is used to determine the probable success of parties and minorities in proposed and newly enacted districts. Most of my experience has been related to congressional and legislative districts, but I have also had the opportunity to analyze municipal and county-level districts.

10. I served for a year and one half as Staff Director for the U. S. House Subcommittee on the Census in 1998-99.

11. I was Staff Director of the Subcommittee when the Census Bureau was proposing to substitute the American Community Survey (ACS) for the use of the decennial long form questionnaire in the 2000 and previous decennial Censuses. The long form was not used in the 2010 Decennial Census.

12. I have drafted and analyzed plans in most states including, but not limited to, California, Nevada, Arizona, New Mexico, Colorado, Texas, Oklahoma, Kansas, Missouri, Minnesota, Wisconsin, Illinois, Indiana, Ohio, Arkansas, Mississippi, Louisiana, Alabama, Georgia, Florida, South Carolina, North Carolina, Virginia, New York, New Jersey and Massachusetts.

13. In this decennial round of redistricting, I have already been intensely involved in Texas, Alabama, North Carolina, Virginia and Massachusetts. As much of my consulting activities involve work in states subject to the provisions of Section 5 of the Voting Rights Act, I am very familiar with the data used to analyze the expected performance of redrawn and newly created minority districts. I regularly advise clients about the characteristics of minority districts in their plans, and whether or not they are meeting the requirements of both Sections 2 and 5 of the Voting Rights Act.

14. I have given testimony as an expert witness in a number of important redistricting cases including, but not limited to, Gingles v. Edmisten, 590 F. Supp. 345 (N.D.N.C. 1984), *aff'd in part and rev'd in part* Thornburg v. Gingles 478 U.S. 30 (1986); State of Mississippi v. United States, 490 F. Supp. 569 (D.C.D.C. 1979); Shaw v. Hunt, 92-202-CIV-5-BR, U.S. District Court for the Eastern District of North Carolina, Raleigh Division (1993-4); Ketchum v. Byrne, 740 F,2d 1398, *cert. denied* City Council of Chicago v. Ketchum, 471 U.S. 1135 (1985), *on remand*, Ketchum v. City of Chicago 630 F. Supp. 551 (N.D. Ill. 1985); and Arizonans for Fair Representation v. Symington, CIV 92-0256, U.S. District Court Arizona (1992), *aff'd mem. sub nom.* Arizona Community Forum v. Symington, 506 U.S. 969 (1992), David Harris v. Patrick McCrory, Civil Action No. 1:13 CV-00949 (United States District Court, Middle District of North Carolina Durham Division 2013) and North Carolina State Conference of the NAACP v. Patrick Lloyd McCrory, 1:13 CV-658 (United States District Court, Middle District of North Carolina 2013).

15. I have done considerable work regarding compactness as a criterion in redistricting maps, including but not limited to a work I coauthored in *The Journal of Politics*, "Measuring Compactness and the Role of a Compactness Standard in a Test for Partisan and Racial Gerrymandering." Id., Vol. 52, No. 4 (Nov., 1990), pp. 1155-1181 (with Richard G. Niemi, Bernard Grofman, and Carl Carlucci).

16. In that work, my co-authors and I discussed the advantages and limitations of various measures of compactness as well as differing definitions. As we stated in the article, "disputes about compactness will be numerous… there are those who would dismiss it outright as well as those who believe in it passionately." We further noted that

"whatever turns out to be its utility as a districting standard, we hope that we have sufficiently clarified the concept so as to stimulate more rational, enlightened discussion of its merits and faults as well as further study of its supposed effects."

17. Both prior and subsequent to my coauthorship of the Journal of Politics article, I have regularly advised state legislatures and others regarding the concept of compactness and regarding the compactness of specific districts and districting plans.

SOURCES OF DATA FOR THIS REPORT

18. In compiling the maps, figures and tables for this report, I have accessed current and historic redistricting plan files for multiple states, which I have access through my present and former consulting work, along with other analyses provided by other redistricting information sources available through counsel. All of the compactness measures have been computed using U. S. Census Bureau's TIGER geographic files which contain multiple levels of census geographic units including, but not limited to, census blocks, voting districts (VTD's), census places, and counties as well as congressional and legislative district boundaries. Current and former political district boundaries are coded into attribute files at the census block level and are commonly referred to as "block assignment files". The geographic boundary information for legislative plans enacted in the decade prior to the 2010 Decennial Census and after that Census is available through U. S. Census Bureau data sources. In some cases actual boundary files for the 1991 Virginia legislative districts have been matched to current census geographic files to "move" block assignment from generated from prior redistrictings into the current 2010 TIGER geography.

19. Compactness tests are an integral part of modern redistricting geographic information systems (GIS) and are part of many analytical reports which can be produced for redistricting plans drafted on a redistricting system. I have used the GIS software developed by Caliper Corporation, located in Newton, Massachusetts. This software package is "Maptitude for Redistricting", and is the most commonly-used software used by redistricting experts across the nation. All the maps used in this report have been produced using Maptitude for Redistricting. The information contained on most of the tables in this report has been compiled from Maptitude reports using Excel, which is a common Microsoft utility spreadsheet software program.

MAKING DETERMINATIONS REGARDING COMPACTNESS

20. Experts in my field are frequently asked by state legislatures or other interested parties to determine whether a map is "compact" under a relevant statutory or constitutional provision. To the best of my knowledge, no state statutes or constitutions define what specific attributes are to be found in a "compact" plan, provide objective tests for measuring the degree to which those attributes are present, or provide numerical or other objective bright lines for determining whether plans or districts are compact.

21. Compactness is a concept in search of a definition. This is so for two reasons. First, there is not complete agreement among legislators, courts, experts, or the general public about what attributes must or should be present in a "compact" district or an individual redistricting plan. Second, even when specific attributes of compactness are isolated, there are multiple methods of measuring those attributes and there is no general agreement about what minimum measurements are required before a district or plan can be considered compact. Indeed, there is not even agreement that a minimum

measurement or bright line should be used for determining whether a given district or plan is compact.

22. Various concepts of compactness can, however, be used to evaluate plans for purposes of comparing one plan to another. These varied concepts are reflected in mathematical tests that attempt to measure the presence of certain attributes. For example, some tests focus on the shape of a district, finding different ways to assign a one-dimensional number to a two-dimensional shape. Some tests focus solely on the perimeter of an area, focusing primarily on intrusions or extrusions and potentially on the size of a district, but not necessarily on how well a district fills in a given area. Other tests focus on population dispersion within a district. Each of these tests rewards certain positive attributes of compactness and penalizes negative attributes.

23. The quantitative scores derived from these tests can be used to make comparisons between plans with respect to certain attributes that the "tester" thinks are important, but they should not be used to eliminate plans that fail to meet a predetermined level. There is no score for any one measure, much less for all of them, when used together, that, on its face, indicates unsatisfactory compactness. Nor can compactness scores be used to rank all possible plans along a single continuum, from perfectly un-compact to perfectly compact.

24. Despite the inability to meaningfully use mathematical tests in applications beyond a simple comparison between two plans, compactness is not a meaningless concept. For example, while there is no precise temperature that marks the transition from hot to cold, we know that 10 degrees is uniformly regarded as cold and 90 degrees as warm. The same can be said of 30 degrees and 70 degrees and other temperatures

closer to the middle, even though there comes a point, not a bright line, where there is no general agreement.

25. In deciding whether a given set of districts are compact, the question that experts ask is not, therefore, whether another plan scores lower or higher using a mathematical test to measure some single attribute of compactness. Instead, experts determine whether the plan is "hot" or "cold;" according to the degree it exhibits the traits of other districting plans that have been determined by legislatures or courts to be compact.

26. For purposes of this report, I have selected two compactness measures which are familiar to courts and widely cited. The first test is called the Reock Test and the second is the Polsby-Popper Test. Both tests are based on the geographic area of a district compared to a calculated circle. Both tests are not affected by the geographic size of the district, or districts, which are being measured.

27. The Reock Test, sometimes described as "Geographic Dispersion Compactness" computes the ratio of the area of a district to the area of the smallest circle that can enclose the district. A "perfectly shaped district' would be a circle for which the area of the district and the circumscribing circle would be the same. The Reock score would be 1.00. Another common geometrically-shaped district would be a square, with a Reock score of 0.6366.

28. The Polsby-Popper Test, sometimes described as "Perimeter Compactness" computes the ratio of the area of a district to the area of a circle with the same perimeter as the district being tested. Once again, a "perfectly shaped" district would be a circle with a score of 1.00. A square-shaped district would have a score of 0.7854.

29. Figure 1 contains examples of three rectangular districts (A, B & C). District A is a square. District B is a rectangle with a width twice as long as its height. District C has a width three times as long as its height. As the rectangle increases in width relative to its height, the Reock score decreases from 0.637 to 0.509 to 0.382. Thus, the Reock test reacts strongly to elongated districts. At the same time, as the rectangle elongates, the Polsby-Popper score decreases from 0.785 to 0.698 to 0.589. The Polsby-Popper score reacts less to the elongation of a district.

30. Figure 2 contains a much more convoluted district with numerous indentations into a basic shape which is almost square. Testing this hypothetical district yields a Reock score of 0.405, but a Polsby-Popper Score of only 0.082, which is much lower. This example illustrates that the Polsby-Popper tests is very sensitive to indentations into the district, or multiple lengthy extrusions. This is the type of geographic feature which might be caused by water boundaries, such as coastlines or rivers, other mountain ridges. The marked difference between the size of the Reock circle and the Polsby-Popper circle is quite striking in this example.

EXAMPLES OF NON-COMPACT DISTRICTS

31. When Justice O'Connor addressed compactness in *Shaw vs. Reno* (517 U.S. 899 (1995)), she was looking at the districts found on Map 1 of this report. These districts were North Carolina's second attempt to draft a congressional districting plan, following the 1990 Decennial Census, which would receive preclearance from the United States Department (DOJ) under Section 5 of the Voting Rights Act. Enacted in 1992, Congressional District 12 was particularly cited by Justice O'Connor as being bizarre in shape. District 12 was declared unconstitutional. It should be noted that District 12 had a

Reock Score of 0.05 and a Polsby-Popper Score of 0.01. Congressional District 1, which is an example of lack of compactness, had a Reock score of 0.26 and a Polsby-Popper score of 0.02. The reason that District 1's Reock score is higher than District 12 is that its width is closer to its length. Both districts are only contiguous by touch, which is not considered to be contiguous in many states, including present-day North Carolina. The compactness scores for the 1992 North Carolina congressional map are listed on Table 1.

32. After North Carolina's 1992 Congressional Plan was tossed out by the Court, the State went through several maps while attempting to gain court approval of its post-1990 Decennial Census congressional map. The final map, passed in 1997 was finally approved by the United States Supreme Court (*Hunt v. Cromartie* 526 U.S, 541 (1999)), and only used in the 2000 Election.

33. In the congressional remap following the 2000 Decennial another map was enacted in 2001 which was in effect through the 2010 General Election. This map, shown on Map 2, shows how Districts 1 and 12 changed though the next redistricting cycle. District 12 had a Reock score of 0.12 and a Polsby-Popper score of 0.03 while District 1 had a Reock score of 0.39 and a Polsby-Popper score of 0.08. In the period from 1992 through 2010 both Districts 1 and 12 elected African-Americans. The compactness scores for the 2001 plan are found in Table 13.

34. The state of Illinois also contains some strangely configured districts which have been crafted to protect minority incumbents from the Chicago area. Illinois has been steadily losing congressional representation for many decades, leaving the Chicago districts severely underpopulated. Map 3 shows the four minority districts anchored in Chicago. The Reock and Polsby-Popper scores for Illinois' 2011 congressional districts

are found on Table 2. All these districts contain minority voting-age population (VAP) percentages in excess of 60% in terms of 2010 Decennial Census numbers. The African-American districts are 1, 2, and 7. District 4 is a carefully crafted to separate the Hispanic population from the African-American population, with a Hispanic VAP of 65.92%. District 2 extends from Southeast Chicago, through the southeast Chicago suburbs, through eastern Will County out into Kankakee County. District 1 begins with a narrow neck coming out of Chicago, into the Cook County suburbs and out into western Will County. District 7 is based in Chicago. It has an extension off the main body of the District to the south side of Chicago connected through a narrow passage just over 500 feet wide. The 7th District also extend west out into Cook county to come within 300 feet of the Cook County-DuPage County line. District 4 is the Hispanic congressional seat which is known by almost all redistricting experts as the "Earmuff District". It carefully wraps around African-American District 7 running between the western boundary of the 7th District and the DuPage County boundary.

35. I have drawn these districts to the attention of the court because they were clearly crafted with only two goals. First was to create three African-American districts and one Hispanic district. They were drawn to add needed population into seriously underpopulated minority districts and were totally race-based in motivation. The second goal was to create three safe seats for Non-Hispanic White Democrats. Congressional Districts 3, 5 and 9, which also are based in Chicago, have Non-Hispanic White VAP populations in excess of 65% and have successfully elected Non-Hispanic White Democrats.

36. In *King v. State Bd. of Elections* (979 F.Supp. 619 (N.D. Ill. 1997) *(King II)*, the court found that, while the Illinois 4th District was irregularly shaped, it was still compact and maintained most of the other traditional redistricting criteria in Illinois. The odd shape was in fact necessitated because of the need to accommodate an existing African-American incumbent. As a result, the court found that the district, which has commonly been referred to as an "earmuff," met the compactness prong of *Gingles* and was therefore narrowly tailored.

VIRGINIA COMPACTNESS ISSUES

37. Unfortunately, real districts cannot be drawn to conform to basic geometric shapes. This is especially true for the state of Virginia, which is irregularly shaped to begin with. Theoretically, states such as Colorado or Wyoming might be divided into simple square or rectangular districts except that, even in these states, the units of geography, which are combined into districts, are not regularly shaped.

38. Virginia has 7,213 miles of tidal bay frontage, 123 miles of ocean coastline, and 457 miles of on-tidal river frontage. Many county lines follow riverbeds, and the State's western boundary runs along over 400 miles of mountain ridges and rivers. All of these physical features would affect some compactness tests, especially the Polsby-Popper test.

39. Virginia's Tidewater region, which runs from the fall line to the Chesapeake Bay, is divided into four major regions by the James, York and Rappahannock Rivers. The boundaries of Virginia's counties in the Tidewater are shaped by these rivers which were historic avenues of transportation in Virginia.

40. Other factors affecting district shapes are the federal constitutional requirement of equality of population and the requirements of the Federal Voting Rights Act of 1965, as

amended. Areas of minority population may not be located in geographic configurations which lend to their inclusion in optimally-compact districts. A state redistricting authority might have to balance other competing redistricting goals against the shapes of districts to draft feasible plans. In Virginia, the Legislature has been afforded considerable latitude in making these policy decisions by the State Supreme Court.

41. Another competing factor is the protection of incumbency interests and maintenance of district core area from one redistricting plan to another. This is equally true for African-American incumbents. In my 45 years of redistricting experience, I have found that most incumbents are unlikely to happily exchange safe districts for more competitive districts, and that also includes minority incumbents.

42. Relative shifts in the balance of population between areas of a state require difficult policy choices. The overriding factor in creating a new districting plan is that, as is the case of Virginia, the map must be enacted by the same legislators who will represent the new districts. If enough legislators do not accept the map, there will be no bill enacted.

43. In my expert opinion, there is no clear national standard or bright line test with which to say that Virginia's current districts meet some theoretical academic standard of permissible compactness. However, Virginia does have a state constitutional provision on compactness, and there are two state Supreme Court decisions which provide considerable guidance and define the compactness standard for Virginia legislative districts. These standards were cited by the House of Delegates a part of their redistricting criteria. See *Jamerson v. Womack,* 244 Va. 506 (1992) and *Wilkins v. West*, 264 Va. 447 (2002). This means that Virginia has a better defined compactness standard

than most states. While I leave the legal implications of these cases for the attorneys, it is instructive to examine the facts approved by the Virginia Supreme Court.

44. In *Jamerson*, the Virginia Supreme Court upheld the chancellor's court's determination that reapportionment of Senatorial Districts 15 and 18, as enacted in Chapter 18 of the Acts of the 1991 Special session of the General Assembly (Code §§ 24, 1-17, 19 and 22), did not violate Article II, §6 of the Virginia Constitution with regard to compactness (See Map 12).

45. The Supreme Court further concluded that proper deference must be given to the wide discretion accorded to the General Assembly in its value judgment of the relative degree of compactness required when reconciling the multiple concerns of apportionment.

46. In *Wilkins v. West*, plaintiffs made a complaint under the State Constitution which mirrors the complaint in this case. The circuit court found for the plaintiffs and determined that the districts did not meet the Virginia Constitution's requirements for compactness and contiguity and found that several of the districts were racially gerrymandered. The Virginia Supreme Court unanimously reversed, finding that all the districts complied with the Virginia constitutional regard compactness and contiguity and, therefore, none of the districts constituted a racial gerrymander.

47. In my expert opinion, the *Jamerson* and *Wilkins* standard of value judgment is clearly satisfied by the evidence cited below. I measured the compactness of Senate Districts 15 and 18 as enacted in 1991 as well as the compactness of all the districts in the 1991 State Senate and 1991 House of Delegates Maps. I will compare the information for the 1991 redistricting plans for both chambers as well as the House of Delegates plans

drafted following the Decennial Censuses of 2000 and 2010. Particular attention will be given to the current districting plan for the House of Delegates enacted following the 2010 Decennial Census.

48. In order to give the court a frame of reference, I have also determined the compactness scores for other Southern states which face the same issues of minority representation.

49. I will also discuss the issue of district contiguity and note some of the reasons that the districts under contention in this case were enacted in their present configuration. Although I did not participate in the drafting of any Virginia redistricting plans this decade, my 45 years of redistricting experience across the nation give me good perspective of the drafter's motivations just from a detailed examination of the district configurations of a redistricting map.

THE 1991 VIRGINA STATE HOUSE AND SENATE PLANS

50. Table 6 contains the compactness scores for all the senate districts enacted in 1991. Both the Reock and Polsby-Popper scores are listed. At the bottom of the table the minimum district score, the maximum district score and the mean district score are shown. Map 12 shows the boundaries of Senate Districts 15 and 18. The Reock and Polsby-Popper score for District 15 are 0.23 and 0.10 respectively and the equivalent score for District 18 are 0.12 and 0.10. For the 1991 Senate Plan as a whole the lowest Reock score was 0.12 (District 18) and the highest Reock score was 0.65 (District 21). In the 1991 Senate Plan as a whole the lowest Polsby-Popper score was 0.10 (Districts 2, 15, 18) and the highest Polsby-Popper score was 0.43 (District 19). It should be noted that District 16 in that plan had a lower Polsby-Popper score of 0.09 (See Map 15) than the

two senate districts specifically cited in *Jamerson*. In my judgment, District 16 is somewhat more bizarre shaped, but because its width is closer to its height it received a better Reock score of 0.33. This demonstrates the problem of just using these mathematical scores to evaluate compactness.

51. The 1991 House of Delegates District 74 was also among the districts examined in *Jamerson* which is important because very similar shapes for this district were adopted in 2001 and 2011 (See Map 19). The 1991 district had a Reock score of 0.14 and a Polsby-Popper score of 0.11. The Virginia Supreme Court did not object to this district (See Table 5). Almost the exact same district was carried over to the 2001 House Plan (See Map13) and then again into the 2011 House Plan (See Map 8). House District 74 in the 2011 Plan had a Reock score of 0.16 and a Polsby-Popper Score of 0.12. Both compactness scores for the 2011 version of House District 74 were better for that same district than in the 1991 Plan.

52. I have included Map 21 which shows examples of 4 additional 1991 House of Delegates districts. These are districts which the *Jamerson* court examined and approved.

53. It should follow, therefore, that if the compactness scores of the 2011 Virginia House of Delegates Plan are not significantly different than the scores accepted by the Virginia Supreme Court in *Jamerson*, then they are compact enough to pass muster under the Virginia Constitution as drawn in the 2011 House of Delegates Plan.

THE 2011 HOUSE OF DELEGATES PLAN (H.B. 5005)

54. I have compiled Maps 4 through 6 which highlight the 12 African-American districts contained in the 2011 House of Delegates Plan (HB5005). District 75 is rural in

character and runs along the Virginia-North Carolina border from Franklin City in the east, to Brunswick County in the west. District 63 stretches from Hopewell City in the northeast through a portion of Prince George County, though Petersburg and a portion of Chesterfield County and out into northern Dinwiddie County. Only a very small portion of the District's population is rural – about 8,000 out of 79,600. Map 4 is the only map which shows District 75 in its entirety.

55. The four African-American districts in the Norfolk-Portsmouth-Chesapeake area (Districts 77, 80, 89 and 90), along with the two African-American districts in the Hampton-Newport News area (Districts 92 and 95), are shown in greater detail on Map 5. District 77 extends out to the southwest into Suffolk County.

56. The remaining four African-American districts, shown on Map 6, are located in the Richmond-Henrico County area (Districts 69, 70 71 and 74). District 74 extend to the southeast to include all of Charles City County which, it should be noted only contains 7,256 people, living in two precincts.

57. Map 16 shows HB5005 in its entirety with insets for the areas running from Richmond to Hampton Roads along as well as an inset for the Northern Virginia districts.

58. Tables 5 though 10 contain the Reock and Polsby-Popper compactness scores for the following current and historical Virginia Senate and House of Delegates Plans.

a. Table 5 – 1991 State House Plan

b. Table 6 – 1991 State Senate Plan

c. Table 7 – 2001 State House Plan

d. Table 8 – 2001 State Senate Plan

e. Table 9 – 2011 State House Plan

f. Table 10 – 2011 State Senate Plan

59. The compactness scores for the districts of the redistricting plans of the Virginia General Assembly following the last three Decennial Censuses are summarized on Table 3. This table lists the minimum, maximum, mean and standard deviation score for both the Reock Test and the Polsby-Popper Test. The 1991 compactness scores for the 1991 State Senate Plan which was the subject of the *Jamerson* litigation are shaded red and the scores for the current (2011) House of Delegates Plan are shaded green.

60. Comparing the compactness scores for these two shaded plans on Table 3 is the most relevant to determine if the 2011 House map meets the *Jamerson* standard. The Reock scores for these two maps are, essential the same. The lowest Reock score for the 2011 House Plan of 0.14 is 0.02 higher than the lowest score for 1991 Senate Plan (0.12). The highest score for the 2011 House Plan (0.62) is only 0.01 lower than the highest score for the 1991 Senate Plan (0.63). The mean scores for the two maps are the same (0.36), as is the standard deviations (0.11).

61. The Polsby-Popper scores for these two maps are, essentially the same or better. The lowest Polsby-Popper score for the 2011 House Plan of 0.08 is 0.01 lower than the lowest score for 1991 Senate Plan (0.09). The highest score for the 2011 House Plan (0.55) is 0.12 greater than the highest score for the 1991 Senate Plan (0.43). The mean scores for the two maps are the same (0.24), and the standard deviation for the 2011 House Plan (0.09) is 0.01 lower than the 0.10 standard deviation for the 1991 Senate Plan. A lower standard deviation score is better.

62. In my expert opinion, the 2011 House of Delegates Plan falls within the discretionary range endorsed by the Virginia State Supreme Court in the *Jamerson* decision.

63. I have also compared the Reock and Polsby-Popper scores for the 2011 House of Delegates map to the same scores for the lower chambers of 8 additional Southern states following their 2010 Decennial Census redistricting. These states are Alabama, Florida, Georgia, Louisiana, Maryland, Mississippi, North Carolina and South Carolina. These scores are found on the top section of Table 4. The same scores for the same states following the 2000 Decennial Census are found on the bottom section of Table 4.

64. Once again, in my expert opinion, Virginia's House of Delegates' Reock and Polsby-Popper scores compare closely with the other 8 states, which all contain numerous minority districts in their maps.

65. Plaintiffs also contend that lack of compactness is somehow indicative of impermissible attention to race when the 2011 House of Delegates Plan was drafted. Districts 74 and 95 are cited as examples of lack of compactness. There are, however four additional districts, with high percentages of non-Hispanic Whites which are similar in terms of compactness scores. These are Districts 13, 17, 22 and 48. They are arguably as lacking in compactness as Districts 74 and 95. The Reock and Polsby-Popper scores for these 6 districts are found on Table 14 and have similar combinations of both scores for both tests.

66. Maps 7 through 11 provide the outlines of the six districts found on Table 14. District 95, located in Hampton City and Newport New City, is on Map 7. District